THE

ELECTRICAL REVIEW.

VOL. XXXV. NOVEMBER 9, 1894. No. 885

CONTENTS:

	PAGE
Gas Engine Competition	545
A Few Remarks about Accumulators	547
Symbols and Abbreviations	547
Light Railways and Tramways	548
A New Arrangement of the Kelvin Balance (*illustrated*)	549
The Colour of the Incandescent Gas Light	550
Electro-deposition of Gold	550
Correspondence:—The Liverpool Overhead Railway	552
The Magnetic Properties of Asbestos	552
Design of Large Alternators	553
Regulation of Pressure on Supply Mains	555
Localising High Resistance Faults in Submarine Cables	555
Electric Lighting at Folkestone	555
Standards of Electrical Measurement	556
Two Lancashire Central Stations:—	
The Southport Electrical Works (*illustrated*)	557
Bolton Electric Lighting (*illustrated*)	560
Notes	564
Business Notices, &c.	565
Contracts Open and Closed	568
Books Received	568
City Notes	568
Traffic Receipts	568
Share List of Electrical Companies	569
Legal:—Muirhead *v.* Commercial Cable Company	570
Interdict Action by the Edison-Bell Phonograph Corporation	574
Newington, Priddle & Co. *v.* Anders Telephone Company	574
Proceedings of Societies:—Physical Society	575
From the Hub of the Universe	575
New Patents	575
Abstracts of Published Specifications	576

THE
UNIVERSAL ELECTRICAL DIRECTORY
(J. A. BERLY'S).

PRICE 4/- POST FREE.
The Leading Electrical Trades Directory and the Oldest Electrical Directory in the World.

1895 ISSUE NOW IN PREPARATION.

PRICE 4/- POST FREE.
Fully Revised and Thoroughly Reliable.
Contains a larger amount of Trade Matter than any other Electrical Directory.

H. ALABASTER, GATEHOUSE & CO.,
22, Paternoster Row, London, E.C.

THE ELECTRICAL REVIEW.
Published every FRIDAY, Price 4d.
The Oldest Weekly Electrical Paper. Established 1872.
TO BE OBTAINED BY ORDER FROM ANY NEWSAGENT IN TOWN OR COUNTRY.

OFFICE:—22, PATERNOSTER ROW, LONDON.

Telegraphic Address: "AGREKAY, LONDON." Code A B C. Telephone No. 517
ALL Letters should be addressed to the Proprietors, H. Alabaster, Gatehouse & Co.
ADVERTISEMENT RATES ON APPLICATION.
The "Electrical Review" is the recognised medium of the Electrical Trades.

SUBSCRIPTION RATES.—In *Great Britain*, Post Free, per Year, 19s. 6d. To all *Foreign Countries* (except those mentioned below), per Year, £1 1s. 6d. *Exceptions.*—Abyssinia, Aden, Borneo, Ceylon, India, Java, Labuan, Mozambique, Penang, Persia (*viâ* Brindisi), Phillipine Islands, Singapore, Zanzibar, to which the rates are: per Year, £1 3s, 10d.
BINDING.—Subscribers' numbers bound, including case, for 4s. each volume.
CASES.—Cloth Cases for Binding can be had, price 2s. 6d. each.
FOREIGN AGENTS.—New York: D. VAN NOSTRAND, 23, Murray Street. *Paris:* VEUVE J. BOYVEAU, 22, Rue de la Banque. *Berlin:* ASHER & Co., 5, Unter den Linden.
Cheques and Postal Orders (on Chief Office, London) to be made payable to Mr. H. ALABASTER 22, Paternoster Row, E.C.

GAS ENGINE COMPETITION.

OUR contemporary, *L'Energie Electrique*, discusses the question of gas consumption in gas engines, specially with reference to a dispute between the French makers of the Charon motor and the Crossley Company's representatives. It appears that after several tests upon Charon motors, the engineers of the Ponts et Chaussée had shown that these motors only consumed 466 to 470 litres of gas per horse-power hour, and forthwith the makers published this far and wide, and guaranteed for engines of over 8 H.P. a consumption not exceeding 500 litres. It is claimed by the Crossley Company's agents that the engine does not exist that will work so efficiently, to which the Charon Company declare themselves ready to submit a 50-horse motor to be installed in Bordeaux, and which they guarantee shall consume less than 500 litres. Our contemporary publishes a brief *résume* of tests made, of the motors best known in France, by their respective makers, and, perhaps, not too rigorously correct, which shows results of 733, 603, 600, 577 and 481 litres per H.P., the latter being the figure for the Charon motor, the Crossley engine showing 603. But tests are of no value without a determination of the calorific value of the gas used, for between a gas such as that of Solre le Chateau, which has a calorific power of 5,980, and one which only gives 5,000, the difference is over 18 per cent., or such that an engine at the place named might only use 600 litres, and yet would consume 700 litres at another town. M. Witz, the recognised French authority on the subject, gives 10 minutes as the least duration of a test.

Further, and this is a most important point, guarantees of a consumption measured by a customer's meter cannot be correct. In exact work gases are reduced to their equivalent volumes at 0° C. and 760 mm. pressure, and an engine-room is far from being at 0° C., and 600 volumes at 0° C. become 654 at 25° C. Further, between Paris and Rodez, for example, the elevations above sea level differ by 605 metres, and apparent consumption must differ correspondingly. Be this as it may, the figures are given from the various prospectuses of the makers, and a second table reducing them all to 25 horse-power is given, both for light running and under full load. Thus reduced to one equivalent, the comparison between the light engine consumption and that of full load can be made. Also a diagram is given showing some results and comparisons. The first point that the figures show is that the Charon motor, which consumes most gas on its own friction diagram, consumes least when loaded, a point difficult at first to explain, but if it be recollected that the Charon motor varies its rate of compression, increasing this as the power developed is increased, there is nothing very surprising in this, for we know that explosive gas engines diminish their consumption as they increase their rate of compression. In spite of the

advantages of high compression, the Charon motor has alone adopted this, and, if we are to believe the Charon Company, it has resulted in an economy of 50 per cent., as compared with all other known motors; and this is the claim, so distasteful to other makers, that has been the bone of contention. The discussion should easily have been terminated by citing the words of M. Witz, the author of the well-known work of great repute, in which he defends himself against ever having attributed to the Charon motor an economy of 25 per cent. beyond its rivals, and expressly states that what he published did not authorise such a use of his figures. M. Witz says: "Let it be sufficient to state that 535 litres, at 0° and 760 mm. of a gas of 5,980 calories per cubic metre, is the exact equivalent of 600 litres of gas of 5,300 calories under ordinary atmospheric conditions of temperature and pressure." The conclusion is drawn that a very high compression is by no means all gain, and without attaching too much importance to the frictional consumption, it must be remarked that the Charon motor shows worst of all on this point, and our contemporary draws special attention to the fact that in the official tests of two motors at La Rochelle by eminent engineers, a 25-horse motor used 7,350 litres of gas running light, only 9,068 litres for 10 H.P., and only 9,215 litres for 15 H.P., or for the last five additional horse-power an increase of but 147 litres, or, say, 29 litres per H.P. Now, at most, 29 litres produce 150 calories, La Rochelle gas having 5,000 calories per metre cube. But the mechanical theory of heat, contested to-day only by perpetual motion inventors, demands 650 calories per horse-power, from which one may draw one's own conclusions as to the correctness of the claim made for the Charon motor, which is probably due originally to a printer's error in the figures taken by the jury of the Lyons Exposition.

It is only at full powers that motors of the Charon type become economical, even if the figures be admitted, and gas engines in practice rarely work at full or even at three-quarter power, the average being about 66 per cent. of full power. In conclusion, these trials at full power are no guarantee to purchasers of the real efficiency of a gas engine; what is wanted is their consumption at part powers, and all guarantees should be on the basis of measurement at the purchaser's own meter, as the ordinary user may be misled by figures of gas consumption reduced to the scientific basis of 0° C. The purchaser may go equally astray if he do not look into the fractional consumption of gas, a small consumption being evidence of good workmanship and not open to be contested, as are short brake trials, in which latter respect the trials at La Rochelle of five minutes' duration are open to criticism. Our contemporary awaits with interest the result of the Crossley-Charon contest, when M. Witz, who has accepted the post of judge, shall have determined them.

Air-Core Transformers.

It is usually supposed in the case of a transformer whose primary is connected to terminals having an alternating potential difference of constant value between them, that the apparent impedance of the primary is diminished on closing the secondary. Under certain conditions, however, this is not the case. The *Proceedings of the Physical Society* (Vol. xiii., part i., October, 1894, pp. 1—32) contains an account of an investigation, undertaken by Mr. E. C. Rimington, upon the behaviour of an air-core transformer, when the frequency is below a certain critical value. The investigation was conducted by means of purely geometrical methods, and conclusively demonstrated that under certain conditions the apparent impedance of the primary is *not* diminished on closing the secondary. Amongst the cases discussed are that of an identical primary and secondary with magnetic leakage; that of two coils with different time-constants without magnetic leakage; and that of two coils with different time-constants with magnetic leakage. Several problems are also worked out in order to illustrate the method employed, whilst reference is made to some experiments conducted in the meter-testing room of the Electric Supply Company, which, though admittedly rough, showed that a distinct increase of impedance took place in the primary on closing the secondary. In these experiments the increase was obtained by employing a primary and a secondary having equal time constants suitably related to the frequency and a pure sine function P.D. The paper in which the investigation is described is not suitable for condensation, and, though it looks severely mathematical, our readers will find it much simpler than it appears to be, owing to the geometrical method having been employed instead of the analytical one. Presumably the reason why increased impedance on closing the secondary of ordinary transformers has not been noticed, is because their "lag-angles" are very large.

Degree of Incandescence of Lamps.

M. Crova, in a recent issue of *Comptes Rendus*, gives the following results of tests made by his photometric system on arc and incandescent lamps, also upon the incandescent gas lamps. In the case of an arc lamp consuming 1,509 watts, the degree of incandescence was 1·5; consuming 1,660 watts, it was 1·7. For a 16 C.P. lamp this figure varied from 1·05 to 1·25 according as the lamp was more or less overrun. The incandescent gas burner gave the following results:—

Candle-power.	Hourly gas consumption.	Degree of incandescence.	No. of feet gas per hour per candle.
44·2	3 4	1·3	0·077
52·3	3 75	1·41	0 0718
53·5	3 65	1·47	0·068

Candle-power increases with degree of incandescence. The refractory substance in the incandescent gas burner appears to stand a higher degree of incandescence than the carbon filament in the electric lamp, and hence it is by far the best gas burner yet invented. Compared with ordinary gas or electric light it has a ghastly colour due to the high degree of incandescence of the earthy mantle. The result of all M. Crova's tests on gas lights are summed up in the following: "In lamps in which the incandescent refractory substance has a fixed value independent of the consumption of combustible, the maximum effect corresponds to the minimum amount of combustible necessary to reach the maximum degree of incandescence."

Gas v. Electricity.—Last Saturday, at the Goldsmiths' Institute, New Cross, Prof. Carlton Lambert delivered an address on "Artificial Illumination in Theory and Practice." Gas as an illuminator was, he said, generally speaking, cheaper than electricity. "With the employment of ordinary burners, of course gas had not the same relative lighting power as electricity; but when incandescent mantles were employed, the illuminating power was increased by at least 200 per cent."

A FEW REMARKS ABOUT ACCUMULATORS.

In a most interesting series of articles, our collaborateur, M. G. Darrieus, naval lieutenant, who is certainly as well acquainted as anybody with the manipulation and the working of accumulators, and especially with their applications to the driving of the most powerful motors that have been constructed (those of submarine boats), shows (and brings forward figures in support of his assertions) how inexpedient it is to couple batteries of accumulators in parallel for any purpose whatever. If we choose elements as similar as possible, and place them under conditions of charge and discharge as analogous as possible, we cannot prevent certain elements from being discharged at pure loss through certain others. His theory is confirmed by the results obtained by experment. The readers of *L'Electricien*, writes M. Leroy, have had before their eyes tables showing clearly the loss of energy entailed by coupling in parallel. We will, however, make one remark: In an accumulator element containing more or less plates, it may happen that, owing to the dropping of active material, to a greater electrical resistance in the contact of one of the plates with the connecting piece than in another, or to some other reason, the various plates composing one element are in different chemical and electrical conditions; it follows therefore that there will be partial discharges between the plates of one element as between the different batteries connected in parallel in the case studied by M. Darrieus.

Moreover, we are not stating any new fact, the phenomena in question being generally referred to under the name of local action, and extending not only to the neighbouring plates of one element, but also to the different points of each plate. It would be interesting (and if one of our readers could devote time and patience to the study of this question we should be greatly obliged to him) to apply to the plates of one element the method followed by M. Darrieus for several couples, and to ascertain, (1), whether positive and negative plates charged in the same box, two and two, from distinct sources of current, but under similar conditions, and then discharged through circuits of equal resistance, first singly and then grouped in quantity, give an appreciably different rendering; (2), if the same plates charged in parallel, and then discharged, first two by two and then together, give better results. As it is not, as a rule, possible to charge or discharge plates in insulated sets of two, the experiment we are proposing does not at first seem to have much practical value; we think, however, that makers of accumulators might profit by it by reducing, for instance, to a minimum the number of plates,* and by rendering the connections as homogeneous as possible (this is an argument in favour of the superiority of connection by soldering, over that by bolts and screws) if it is shown that these modifications appreciably affect the rendering of the batteries.

Following out this line of argument, are we not justified in thinking that to substitute new electrodes for the damaged plates of an element is a dangerous remedy, since this substitution introduces into the same box electrodes in very different electrical and chemical conditions, amongst which very powerful local action might be set up? these local effects might quickly bring about the total destruction of the plates not charged.

We will conclude these remarks by mentioning another interesting experiment that might be tried, and that would be more instructive from a practical point of view. There are two modes of coupling accumulator plates; the first, which is generally adopted, consists in connecting electrically the plates of the same name of each element, then the group of positive plates of each accumulator to the negative group of the following one; the second mode leaves the electrodes of one element insulated from one another and couples each anode of one of the boxes with one of the cathodes of the next.

It seems that other conditions being equal, the second system is the more perfect from a theoretical point of view, in fact, except in the extreme couples at which the current is received, as the electrodes are insulated, the local actions should be reduced to a minimum. Here, again, it would be easy to see whether theory is confirmed by practice, by giving a series of charges and discharges as similar as possible, first leaving insulated from one another the points of connection of the electrodes of contrary polarity of each of the adjacent couples in the second mode of coupling, and then connecting them electrically; the comparison of the renderings obtained would show on which side the advantage lies.

It is evident that considerations of an industrial or commercial nature will have more weight than purely theoretical considerations in deciding what system is to be adopted, but we believe that the remarks suggested by M. Darrieus's researches do not occur in the works treating these questions; we think, therefore, that several of our readers may profit by them by completing them at need by their own personal observations.

Accumulators, which have at the same time so many detractors and so many warm partisans, are, of all electrical apparatus, the least understood; the batteries, supplied with or without a guarantee, are often used and misused most recklessly. A friend of ours, an eminent and skilful engineer, owned to us recently that he had persisted in charging, for a considerable time, a battery which had been delivered to him as ready for use, inadvertently reversing the nature of the current; not obtaining the result guaranteed, he was blaming the maker, when he perceived his mistake. Another friend, manager of a central station and well acquainted with his profession, declared to us that his batteries of accumulators accommodated themselves very well to a system of discharge at a very high rate. However, enthusiasm generally brings about the desired result now-a-days; I am only afraid that, like the ass which the farmer had little by little accustomed to do without food, the batteries will fail just when they are about to accustom themselves to be discharged on short-circuit.

* Mr. Epstein reduced his plates to three long ago.—Eds. Elec. Rev.

SYMBOLS AND ABBREVIATIONS.

The following letter appeared in the last copy of the *Electrical World*, of New York, on the subject of Prof. Jamieson's recent criticisms and recommendations:—

Sir,—I have read the article in the London Electrical Review which contains Prof. Jamieson's criticisms of the system of all symbols and abbreviations recommended by the Chicago Congress, and I wish to make some observations in reply.

He objects to the French script letters, and would use instead block or Clarendon letters, because the latter are more common and more easily made. But this proposal violates one of the fundamental principles of the Congress system, namely, to use script or oblique letters as symbols for quantities and perpendicular letters for the names of units or their abbreviations. Block letters such as M, H, B, are very suitable for representing general units, that is, units independent of any particular set of fundamental units; for example, L for any unit of length, T for any unit of time; L : T for the general unit of velocity. For purposes of instruction this use of block letters is very convenient, and, I believe, was first made in a volume of mine on *physical arithmetic*. By Clarendon letters I understand black letters, hooked at the ends and corners, as **L**, **T**; they were introduced into analysis by Heaviside for the purpose of denoting vector quantities. Would it be right to seize and appropriate for a different purpose, the type which the vector analyst has preempted, and which is required in the higher investigations of electrical science?

Prof. Jamieson is not satisfied with the length of the names ohm, dyne, and erg, but would use ω, δ, ϵ, for short. But ω, δ, ϵ, are not abbreviations formed after the principle of the Hospitalier system; they are rather arbitrary marks. Besides, it is a principle of that system that Greek letters should be reserved for symbols, and the Frankfort Congress recommended a further restriction, namely, to denoting angles and physical constants.

As the sign for "per" he prefers the solidus to the colon, and gives as reason "A line, so /, always signifies *per* or $\div$ *by* in mathematics." This is not quite exact, and in a critic of the Congress system we expect the utmost precision. The sign / signifies *per* or *divided by*, and is equivalent to :. In the names for units it is the hyphen, not $\times$, which is used to denote the product connection; consequently where the quotient connection is to be expressed in a name, a sign other than the algebraic sign of division may be preferable. But, be that as it may, it is certain that the colon is the more

ancient sign, and also that some of the innovations which have been introduced in connection with the solidus are far from being unobjectionable. The use of the solidus is subject to an ambiguity which has never been settled by a distinct convention. With some writers $a + b \mid c + d$, is used to mean $\frac{a+b}{c+d}$ with others to mean $a + \frac{b}{c} + d$. The latter, though not the usual, is doubtless the correct meaning; to express the former brackets are required, thus $(a + b) \mid (c + d)$. Why are the brackets unnecessary in the usual notation? Because the horizontal bar serves as a vinculum as well as the sign of division. Thus the linear plan of writing algebraic expressions labours under the disadvantage of requiring a more extensive use of brackets. Also, it is not so synoptic, for the field of exact vision taken in by the eyes at a glance is not a strip, but a circle. By its inventor, Stokes, the solidus was intended merely as a means of printing an algebraic expression linearly when it occurred in the middle of the text.

Prof. Jamieson objects to *v*, *g*, and mho as unnecessary, and prefers the reciprocal expressions $\frac{1}{u}$, $\frac{1}{\text{R}}$, and $\frac{1}{\omega}$. Were he logical he would write these $/ u$, $/ \text{R}$, $/ \omega$. But it is not a new idea to express the reciprocal of a unit in the same manner as the reciprocal of a symbol. Any one, not a Gael, finds a difficulty in pronouncing *mho*, but how are we to pronounce $\frac{1}{\omega}$? Only by means of a many syllabled phrase.

He thinks M L^2 sufficiently concise for moment of inertia, and *m l* quite good enough for magnetic moment. Electricians, on the contrary, will hold that each of these quantities is of sufficient importance to demand a special symbol for itself. For electric power he considers that W_P is better than P, because the former signifies power in watts. But it is a principle of the Congress system that P as a symbol does not refer to any unit, and as a numerical value it may be used with reference to any unit of power, whether watt, or kilogrammetre per second. Besides, W is the symbol chosen to denote work. For current he prefers *c* to *i*, because "intensity" has no meaning in the phrase "intensity of current." This objection was before the Committee of Congress, and as it is a matter not of error, but of preference, it is surely binding on electricians to accept their decision.

Thus it will be seen that the proposed modifications of Prof. Jamieson are based on personal preference, or on a failure to grasp, or, at least to respect, the fundamental principles of the recommended system. Their tendency would be to change a logical system of notation into a miscellaneous jumble of shorthand.

Ithaca, N.Y. ALEXANDER MACFARLANE.

LIGHT RAILWAYS AND TRAMWAYS.

A LETTER has been addressed by the Board of Trade to the Associated Chambers of Commerce, the London Chamber of Commerce, the Railway Companies' Association, the Institution of Civil Engineers, and other Associated Public or Corporate bodies, which may have very important and far-reaching effects. It is nothing less than a request for information as to the formation of a conference of representative men with a view to considering how far and in what way the hard and fast rules of the Board of Trade in regard to railway construction may be modified or relaxed for the purposes of light railways, built with a view to facilitate transport in the agricultural districts. At present, as is well known, there are provisions as to minimum requirements from which there is practically no deviation, even for a feeder line of a few miles in length, which must be constructed with the same solidity and expense as a first-class main line. We are not among those who believe that British agriculture has been entirely ruined by the railways, nor do we place much credit in the frequent reports which appear in the daily press as to farmers having sent so many tons of this or that article to market and received about twopence for their trouble after paying carriage. Actual personal experience and frequent trials have shown us that the farmer in his own field or yard demands as much for his produce as it can be purchased for in suburban London, and that so far from a farmer being compelled to sell his produce for a matter of sixpence per ton, he asks within one halfpenny a pound, of London retail prices, of a customer who will pay his own carriage. Our experience of the farmer is that he is well able to take care of himself. At the same time there can be no doubt that, like all other traders, the farmer has been squeezed by the railways, whilst the foreign producer, be he a producer of iron, wheat, steel rails, or cabbages, has been favoured. Now it is certain that if a railway finds it pay them to carry a ton of red wheat for sixpence over a given length of line, it can equally well afford to carry white wheat for the same price. We are face to face with the fact that if the farmers were given the same rates as the foreign producers, they would probably cease to complain so bitterly, and the question of relief from Board of Trade rules would have less weight. Railway companies are not in the habit of abating their charges until they are compelled to do so. Lancashire had to build a ship canal at a cost of over twelve millions sterling, simply because the railway charges had grown far beyond what they were in the old days of the road teams and canal, and now the freight on cotton has been reduced by three times the amount, which, if granted in 1880, would have effectually choked off the ship canal enterprise. According to the evidence of the London and North Western Railway in opposing the canal, that company are now carrying goods at a heavy loss in South Lancashire, and yet American railways can and do carry for many times less than the lowest rates of our English companies. It will not altogether do to argue that it is entirely due to expensive construction that rates are high, for this is not the case. Those lines which charge most for a given service, by no means pay the best dividend, and we must not be carried away by the cry for light railways. Certainly we think that such lines could be built to pay, but they must not be in the hands of the old companies unless special limitations be fixed by their Act, as to charges, and, because of the hold now had upon the main lines of communication by the old railway companies, we do not see much direct help to the farmer by building a light railway of a few miles at his end of a main line to London, or to Birmingham, but we do see value in a light railway into the nearest town or nearest available port or line of water carriage. Such lines cannot hope for a heavy traffic, and it is therefore essential that structural expenses be light. Speed is not essential, and with limited speed, structures as well as vehicles can be light. Why, it is often asked, do we find on common roads vehicles with light framing and spider wheels, and upon the perfect level of a railway, massive construction? This is simply an effect of power and speed, for otherwise the action of a smooth and level rail could not be half so destructive as a paved road. Unfortunately, however, light railways have been far from light in practice. Too great a speed is attempted, and the result is massive construction. With a moderate speed, but little in excess of the one-horse 'bus, such as contents the quiet dweller in the country, whose object is a cheap means of transporting himself and his parcels, and not a lightning speed, vehicles may be correspondingly reduced in weight. Both the risk of breakdown, and the results of a breakdown, are minimised at low speeds, and in this direction, if at all, must be sought any easement of the present Board of Trade rules. For purely goods traffic many other things could be eliminated that are now enforced. But the light railway will not find its success other than as a mixed traffic line. American railway practice has shown how, with low speeds, enormous train loads can be drawn thousands of miles at very low tonnage rates. But the stock used on American railroads would not stand the speed and the shunting shocks to which our short and stiffly built waggons are subjected. To the American, who does not realise that English goods traffic is conducted at speeds much higher than the great bulk of American passenger traffic, the English goods waggon appears a fraud, too heavy for its load and unscientific. But the American himself out Herods Herod when he comes to build passenger cars for high speed. He piles up the deadweight per passenger enormously. Experience points to speed being the all-important factor in cheap transit and light vehicles are possible only with low speeds. We have seen how tramways have extended in America, and people who are unaware of American conditions are apt to think Americans enjoy special privileges in the way of traffic. But comparing London with New

York, we should require to class all the omnibuses of London as tramcars, for in London an omnibus is as smooth a vehicle to travel in as is a tramcar in New York, where, except on a few streets, omnibuses are out of the question for want of suitable paving. But the very presence of so many tramways where necessary has lead to their extension to outside districts in which their need is less apparent. Something of the sort would occur here with an extension of railway facilities into the country, rather than as now, through it, for nothing strikes an American so forcibly as the complete isolation of our railways from the country through which they pass. Our railways were, in fact, built from the outset to connect big towns. Hence their names as Stockton and Darlington, Manchester and Liverpool, London and Birmingham, Bristol and Exeter. Compare with the American railroad names, New York and New England, Chicago and North-west, indicating rather a district than a city at each terminus. In America the railways preceded settlement, being almost necessary to settlement, and this is why we see the trains inextricably mixed up in every place passed through with the carts, children, and life generally, whereas here it is only an occasional village that is seen from the railway, and then if near it is apt to be 100 feet below the railway viaduct.

There are obvious disadvantages in a break of gauge, for this implies a disability to use ordinary railway stock, and this, again, means an additional handling of goods, but to build a line to use ordinary vehicles like that to Upwell and Outwell, to which we have before made reference, implies heavier rails, more costly bridges, and an altogether different *régime* from what we think would prove feasible in many country districts that could find traffic for a really light railway. Many advocates of electric traction, well meaning, no doubt, if mistaken, limit their views of the subject to the consideration of 100 miles per hour expresses in entire forgetfulness that such speeds are impracticable for most purposes, and that to confine electric traction in such narrow limits is to practically debar its employment altogether. Now, for very small powers the steam locomotive is less suitable than it is on a large scale, and at small powers and slow speeds it has less advantage over electric traction than at high speeds. The main question is that of power, and so far as the application of electricity is concerned, we confess that we do not see how in numerous cases this could be applied to advantage, excepting so far as it became a day load of a system of electric lighting to some town on the route of the railway. That the two enterprises should be worked in common occurs as a self-evident proposition, the fulfilment of which would go far to show more advanced people in the cities how intolerably foolish their actions appear, in so far as they exhibit so lamentable a want of economy in respect of the reduplication of steam plant for lighting, pumping, and tramway work, when an agent, so easily distributed as electricity, could as well be applied to all three purposes from a single power station of little more capacity than that necessary for the day load or the night load, whichever happened to be the greater. Seeing how easily electrical energy can be distributed, it cannot be said that we have as yet witnessed a particularly intelligent appreciation of the fact by electrical engineers. All kinds of mad schemes are propounded for utilising electricity, and yet the minute subdivision of power stations continues to be carried on and no attempts made to economise.

Electricity will, we feel convinced, prove the final motive power for light railway purposes, and there must be numerous localities where a really light railway could be made to pay.

Horse and steam tramways have no signalling apparatus. This is because at the moderate speeds employed, the vehicles can be stopped in a few feet by a simple hand-worked brake. Here we see at once how low speed eliminates a large expense, and all other expenses are either reduced or abolished by this same factor. No one can travel much about the country without noticing how on the short branch lines, where a train is run to and fro between the main line junction and the outlying town some two to six times daily, a heavy locomotive with its driver and stoker is occupied all day, so far as regards having its fire alight, for a very short period of actual work, and for very few passengers. These branch lines are most expensively constructed, and are worked with full sized rolling stock. Even if ever expected to form portions of a through route, it would be cheaper to rebuild should such time ever come, than go on for years incurring interest on a heavy capital. The interest saved would rebuild the line when needed. Take such a line as the Quainton and Brill, with its two trains daily each way, or many similar cases that may be picked out from the pages of Bradshaw. While we would not contend that it could pay to keep the one shuttle train running to and fro all day for the few passengers between two so unimportant places, few will deny that if the number of trains were increased there would be an increase, though, perhaps, not a proportional increase, in passengers. The train men, anyway, and there will now be three of them, must be paid. Had this been a light tramway, one man could have run three times the daily mileage now covered, for the rate of speed is only about six miles per hour average at present.

There is ample scope for the discussion of the questions raised by Mr. Courtenay Boyle's circular letter, and if properly handled, considerable good may arise. Comparing the safety of our own railways with those of the United States, it cannot but be acknowledged that the heavy expenditure on safeguards is amply justified by the results, the laxity of American practice resulting in an enormous crop of fatalities. But the question is so entirely one of speed and traffic density that it may almost be laid down as a rule that danger is the direct outcome of speed, other things being equal. There is no danger in speed itself on a suitable line properly protected by signal, but all these safeguards are expensive, and the Board of Trade rules have been drawn very tight even on short branches or purely goods traffic lines, and it will be the business of the conference, if constituted, to determine how and when such regulations may be relaxed with safety. There seems here a chance for electrical traction to show its powers in everyday work rather than in some impossible visionary scheme of 100 miles per hour speed. We have already (Electrical Review, August 10th, 1894) indicated a direction in which we think electric traction might receive a trial at no very great expense, viz., on the roads leading into London, and without the use of rails, using electricity in place of steam as the actuating power for a road engine. To make the trial would be a very simple matter, involving the erection of a mile, more or less, of overhead wire, and the addition of a motor to an ordinary road engine. The expenditure of energy would be easily ascertained.

As to the construction of light railways for farmers to bring produce to the present railways, this is out of the question where the railway to be fed by the light line is of the nature of the South Eastern or the Chatham lines, whose charges are so onerous and service so bad. It is useless attempting to feed a railway whose management has insufficient intelligence to welcome traffic. In the Midlands, however, if light railways could be built to give farmers better access to comparatively near towns, the opening of new markets might be made a means of compelling the old railways to reduce their charges so as to retain business—an inducement that does not act with some southern lines, for their managers are indifferent whether they secure traffic or lose it.

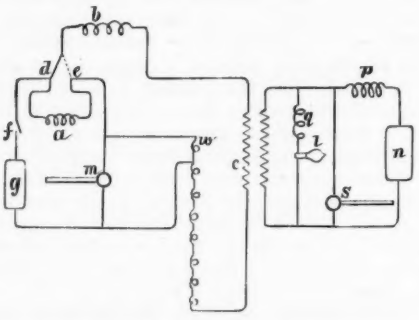
Given, then, the powers to make light lines, there will need to be a very careful consideration of the circumstances of each case, no general rule being applicable all round. Finally, we would add that we believe there would be quite a considerable passenger traffic in quiet districts. Country people stay at home because they cannot move far without harnessing their horse, if they have one, and the trouble is greater than the desire to move. Given a cheap railway, they would get into the way of using it frequently.

A NEW ARRANGEMENT OF THE KELVIN BALANCE.

A simple arrangement for increasing the delicacy of the Kelvin balance when used as a wattmeter in testing transformers has been devised by Prof. Carus-Wilson, of McGill University, Montreal, Canada, and appears to be a material addition to the usefulness of the instrument. A balance with this modification was exhibited by the Professor to the members of the Canadian Electrical Association during their

recent convention at Montreal, and the advantages of the arrangement were demonstrated by its use in a test on a transformer.

The apparatus was arranged as follows:—A Kelvin composite balance carried the primary current through its fine wire swinging coil, *a*, and its fine wire fixed coil, *b*, to the primary of the transformer, *c*, when the switch under the instrument was connected to *d*. If, however, the switch be connected to *e*, and the terminal, *d*, connected through a switch, *f*, and a non-inductive resistance, *g*, to the main, the fixed coils then carry the primary current, and the swinging coils are connected as a shunt, so that the instrument will read watts, all that is necessary being to know the reading of the instrument as an ammeter and the resistance of the shunt. When the switch was placed to *d*, the primary current was read off, and immediately afterwards the switch was turned to *e*, and the primary watts obtained.



It will be noticed that the difference between this arrangement and the usual one, is that the fine fixed coil carries the primary current instead of the thick fixed coil, and, further, the connections are so arranged that the current readings can follow the watt readings without any change in the connections. By this simple modification the delicacy of the instrument was increased, so that with the lightest weight, 12·5 watts gave a range over the whole length of the scale, while with the ordinary arrangement, and the same resistance (200 ohms) in the shunt circuit, 12·5 watts would only give a range of one division of the movable scale. Since the watts in the primary of a transformer on open secondary may be as low as 60 or 70, it is of importance to have a wattmeter with the wide range at low values, obtained by this arrangement.

In the experiment shown, the shunt circuit was connected to one of the eight coils, w, of the fixed armature of a Mordey alternator which supplied the current, so that the watt values were obtained by multiplying the readings by eight. The primary volts were observed by a Cardew voltmeter, *m*, kept in the circuit, and arranged so that its reading could at any moment be checked against the Kelvin balance used as a voltmeter. Thus when the primary current had been observed, the apparent watts could be arrived at, and hence the power factor and the angle of lag.

The power in the secondary circuit of the transformer was taken up in a rheostat, *n*, made specially for McGill University by the Carpenter Enamel Rheostat Company. In this rheostat, which is capable of absorbing 5,000 watts, any current from 1 to 50 ampères, rising by 1 ampère at a time, can be drawn from a 100-volt circuit. The current of the secondary passed through the fixed coil, *p*, of a Siemens dynamometer, while the swinging coil, *q*, was connected as a shunt with a 50 C.P. incandescent lamp, *l*, between the two terminals of the secondary. A special arrangement had been made in the dynamometer, by which the fixed and swinging coils were quite separated, and, knowing the constant of the instrument as an ammeter and the resistance of the shunt, the watts in the secondary were at once obtainable, and hence the efficiency at different loads. The drop was observed by a Cardew voltmeter, s. An electrostatic voltmeter is sometimes used in the secondary circuit, as not absorbing power and avoiding possible error in consequence. The lamp in the shunt circuit is assumed to be without self-induction, but for a permanent testing set, a non-inductive resistance made especially for the purpose would be preferable. The non-inductive resistance in the primary shunt is supplied with the Kelvin instrument, and is made with special terminals for multiplying the readings by two or four.

The whole of the apparatus was very compactly arranged on a table set apart for transformer tests in a room directly over the dynamo room. The wires from the alternator were brought up through the floor, and the primary volts could be held at any required reading by a rheostat in the field circuit, placed close to the table.

In concluding the description of the apparatus, Prof. Carus-Wilson said that in his opinion the Kelvin balance was well suited for uses of this kind, as it could be made to do duty as wattmeter, voltmeter, and ammeter, but had the disadvantage that it was not portable, and required careful handling.

THE COLOUR OF THE INCANDESCENT GAS LIGHT.

A CAREFUL comparison of the intensity of the different colours in the spectrum of Auer's incandescent light with the corresponding colours in the spectra of the incandescent electric light, of the arc light, and of sunlight, has recently been made by Von K. Mützel * by means of the Glan-Vogel spectroscopic photometer. The relative brightness of each colour in the two spectra compared, was estimated on the assumption that the yellow light was of equal brightness in both. The table gives the ratio of the electric incandescent light, the arc light, and sunlight, respectively, to the Auer light.

Wave lengths in millionths of mm.	Colours.	Ratio of electric incandescent light to Auer light.	Ratio of arc light to Auer light.	Ratio of sunlight to Auer light.
800	extreme red	4·04	0·57	0·34
760	red	2·59	0·73	0·53
686	red	1·67	0·80	0·62
656	orange	1·15	0·90	0·92
589	yellow	1·00	1·00	1·00
570	yellow	0·95	1·08	1·19
542	yellow-green	0·83	1·23	1·72
527	green	0·81	1·66	2·13
517	green	0·79	2·02	2·60
500	blue-green	0·91	2·48	4·35
486	bright blue	1·00	3·32	5·91
466	bright blue	1·05	4·06	6·79
458	bright blue	1·10	4·69	7·69
447	dark blue	1·20	6·67	8·75
431	dark blue	1·36	10·52	12·63
423	violet	1·51	18·32	18·77
416	violet	1·74	28·78	25·54

From this table it is evident that the electric incandescent light has far more red light than the Auer light, but that in the green colours the Auer light excels the electric light. In the bright blue the two kinds of light are almost equal, while, in the violet the electric lamp has again a slight advantage.

In the arc light the numbers increase steadily from the red to the violet. It therefore follows that the arc light is inferior to the Auer light in red and orange rays but far exceeds it in blue and violet. Much the same holds true when we compare sunlight with the Auer light.

The results of Von. K. Mützel's experiments will enable anyone to select the light most suitable for his requirements. For instance, where warm colour tones are required the incandescent electric light is to be preferred to the Auer light, and where cold colour tones are to be avoided the Auer light is to be preferred to the arc light.

ELECTRO-DEPOSITION OF GOLD.

By E. ANDREOLI.

To dissolve gold from its ore by means of a cyanide of potassium solution is one thing; to catch or fish out the gold from the cyanide of gold solution and to recover the precious metal is another thing, rather difficult, as gold cannot be precipitated from a cyanide solution by sulphate of

* *Elect. Zeit.*, August 30th, 1894.

iron or sulphuretted hydrogen, as from a chloride of gold solution.

In the Transvaal, at present, gold is precipitated by zinc shavings; an old and crude process, which ought soon to be replaced by a much more rational and practical method of electrolytic deposition.

Mr. A. von Gernet has read, before the Chemical Metallurgical Society of South Africa at Johannesburg, a paper on the Siemens "Electrical Precipitation of Gold," which I will summarily describe, and, later on, very likely criticise and compare with other similar processes.

"The electric current decomposes a solution of metallic salt, the metal being deposited on the negative pole, while the *metalloid* is liberated at the positive pole of the electrolytic cell. In a fixed time a given electric current will deposit a certain quantity of metal, which quantity varies for different metals in direct proportion to their electro-chemical equivalents. This law holds good only for solutions strong in metal, but with very dilute solutions, as in use in the cyanide process, the current does not find sufficient of the metallic compound present at the electrodes, and, consequently, decomposition of water also takes place. For this reason, to make the efficiency of the precipitations as great as possible, constant diffusion of the solution is requisite.

"In order, therefore, to create an artificial diffusion a mechanical movement of the solution is important, and the most economical and convenient way of effecting this is to allow a slow but steady flow through the precipitation boxes. But it is still more important to give a very large surface to the electrodes. In fact, a better effect is obtained by doubling the number of plates than by increasing the current tenfold."

What is the metalloid liberated at the positive pole?

I should have desired to know how much gold in this particular case is deposited in a given time by a given current.

I note *en passant* what Mr. Gernet says, that Mr. Siemens was "the first applicant for and holder of the first patent in the Transvaal for the extraction of gold by means of cyanide." There is no firm in the world who have taken so many patents as Messrs. Siemens & Halske.

With regard to the statement that "in 1887 Dr. Siemens found that the gold anodes used in electroplating at his works in Berlin lost weight when standing idle in the cyanide liquor without any electric current passing through the bath. This fact, backed by the statements of chemical authorities that gold is soluble in cyanides, first induced him to try the use of a cyanide solution to extract gold from ores."

The solvent action of cyanide of potassium on gold was generally known much before 1887.

It is not quite clear to me how the circulation can help much in this particular case when the solution is very dilute, and contains very little gold and very little cyanide of potassium, such as 5 dwts. of gold per ton in 100 tons of solution equals 25 ozs. to be deposited in 24 hours. In all the electrolytic plants circulation is essential.

What is still less intelligible is the attack on the mercury system, the Molloy system I suppose. "The electrolytic method," says Mr. Gernet, "requires 10,000 square feet of surface, and if the bottoms of the precipitation boxes were covered with mercury it would be necessary to have it at least ¼-inch deep, to make up for differences of level, and thus ensure that the whole surface should be covered. This requires over 200 cubic feet of mercury, weighing 80 tons. Not only the initial expense, but also the trouble in cleaning up makes the use of mercury in this way as an electrode impracticable."

Electro-amalgamation takes place in a special manner, as the contact of the liquid flowing on the mercury is intimate and continuous. In no case, 10,000 square feet of mercury, equal to 200 cubic feet and weighing 80 tons, would be necessary.

"To obtain a satisfactory cathode a metal must be used which will fulfil the following conditions:—(1) The precipitated gold must adhere to it; (2) it must be capable of being rolled out into very thin sheets, to avoid unnecessary expense; (3) it must be easy to recover the gold from it; (4) it must not be more electro-positive than the anode, in order to prevent return currents being generated when the depositing current is stopped. The more suitable metal for the purpose is lead, which is, therefore, used in the Siemens process, and which meets all the requirements of the case."

The fourth statement is rather a puzzle and wants thinking over. The weak point is the important question of anodes, which does not seem to have been settled in a very successful manner.

"By the action of the current a *metalloid* is liberated at the positive electrode, and the latter when a metal begins to oxidise. Carbon could be used as an anode; but it will not withstand the action of the current, and soon crumbles into a fine powder, which decomposes cyanide. This finely divided carbon is in suspension, and cannot be removed from the solution by filtration. Zinc used as an anode forms a white precipitate of ferro-cyanide of zinc by the reaction of oxide upon ferro-cyanide, formed during the leaching. Similarly iron anodes form Prussian blue by the reaction of oxide of iron and ferro-cyanide."

What an idea to use zinc as an anode! This question of iron anodes has not been well understood, studied or worked, or perhaps Mr. Gernet did not like to show how iron can be used at the positive pole in a cyanide solution. Is it not the cyanide and not the current that destroys carbon at the positive pole? The fact is that this electrolysis of a very dilute solution of cyanide of potassium and gold solution comes to almost the same thing as the electrolysis of water.

We must note that in order "to precipitate the gold from cyanide solutions only a very weak current is required—that is to say, a density of about ·06 ampère per square foot. With cathodes about 1½ inches apart 4 volts is sufficient to produce this current strength. Little motive power is required, 746 watts equal 1 H.P.; 3,000 tons plant requires 2,400 watts, equal theoretically to 3½ H.P., and actually requiring about 5·0 indicated H.P. In other words and in plain English, Messrs. Siemens use an E.M.F. of 4 volts and 600 ampères. The most important feature of electrical precipitation is that it operates on the solution quite independently of the amount of cyanide or caustic soda it contains."

"Precipitation by means of a chemical reaction is invariably more complete with a solution strong in cyanide than with a weak one, but with electricity is *absolutely of no importance whatever*."

Electroplaters will be much surprised to learn that a weak solution is as good as a strong one.

These 100 tons of gold contain 500 dwts., 1 oz. = 20 dwts.; therefore the total gold = 25 ozs. or about 800 grammes.

The yield of gold per ampère hour is, in the electroplating processes, 2 grammes 485. We must make an allowance, considering that the solution used by Messrs. Siemens is weak and the intensity very low, still, 10,000 square feet is something enormous. How many times during the 24 hours does the solution pass through the four depositing tanks?

It is difficult to accept statements such as the following:—"Precipitation by means of a chemical reaction is invariably more complete with a solution strong in cyanide than with a weak one, but with electricity is absolutely of no importance whatever. Moreover, however acid the solution may be when entering the boxes, the precipitation takes place equally well, the same amount of gold being recovered as from a neutral or alkaline solution. A solution containing only ·01 per cent. cyanide strength will be perfectly suitable for electrical precipitation, though difficult to deal with by the chemical method."

The installation at the Worcester works is the following: There are now in use five leaching vats of 20 feet diameter, with 10 feet staves, each holding 2,700 cubic feet. One tank is discharged and filled every day. The strong solution used contains from ·05 to ·08 per cent. cyanide, and the weak washes ·01 per cent. The actual extraction of fine gold has averaged 70 per cent., while the consumption of cyanide has been ¼ lb. per ton of tailings treated.

The precipitation plant consists of four boxes, 20 feet by 8 feet by 4 feet.

The anodes are iron plates, 7 feet long, 3 feet wide, ⅛th inch thick.

"The lead sheets are stretched between two iron wires

fixed in a light wooden frame, which is then suspended between the iron plates.

"The lead, which contains from 2 to 12 per cent. of gold, is then melted into bars and cupelled. The consumption of lead is 750 lbs. per month, equal to 1½d. per ton of tailings. The working expenses, everything included, come to 3s. per ton."

Mr. Gernet is silent on the yield of gold; how much does he recover from the solution? The lead in this process contains, according to him, from 2 to 12 per cent. A 10 per cent. margin is a very wide one. Does he precipitate the whole of the 25 ozs. of gold in 24 hours?

We know all about the cyanide solutions, the tanks, the anodes, the cathodes, the volts, the ampères. We know that 5 H.P. are required, that the treatment of a ton of ore containing 5 dwts. costs 3s. But we are not told whether all the gold is recovered, or to what extent the solution is exhausted.

In conclusion, a more original and perhaps, also, a better process could be found, and from the electrolytical point of view, it is very difficult to see in what way it differs from the ordinary electro-deposition method, and in what way it is theoretically or practically an improvement on what exists since many years.

CORRESPONDENCE.

The Liverpool Overhead Railway.

Having read the article under the above heading in your issue of October 26th, might I suggest another way of reducing the figures to "reasonable" quantities than that adopted by the writer of the article?

Three things were, apparently, measured in the use of the plant:—The coal = 4,032 lbs., E.H.P. hours = 1,195, and the I.H.P. from which the efficiency $= \frac{\text{E.H.P.}}{\text{I.H.P.}} = 88$ per cent.; therefore the coal per E.H.P. hour = 3·37 lbs.

Taking the evaporation—assumed as "reasonable" in the article—at 7 lbs., we get the water per E.H.P. hour = 23·6 lbs. Again, the reasonable water consumption per I.H.P. hour is given as 16 lbs. of water.

Thus $\frac{\text{water-power I.H.P. hour}}{\text{water-power E.H.P. hour}} = \frac{16}{23·6} = 0·68.$

Thus, in order that the evaporation and consumption of water per I.H.P. hour may be reasonable quantities, the efficiency must be reduced from 88 to 68 per cent., if we are to make them fit in with the measured quantities of coal and output.

The writer of the article prefers to doubt the accuracy of the coal measurement, and so leaves the efficiency at 88 per cent., which to him seems reasonable.

But surely of the three quantities measured the coal is the least difficult to get accurately, and the I.H.P. the most difficult; the former depending only on the scales which can be checked against standard weights, but the latter on the indicator springs, their freedom from sticking, the length of the connecting pipe to the cylinders, the correct observation of the speed of the engine, and its maintenance at that speed during the taking of the cards. It might be that the thickness of fires at the start and finish would make an error in so short a test, but this would hardly be likely to tell *against* the plant in the present case. Of the two, I should prefer to doubt—if one may be allowed to do so—the measurement of the I.H.P., even if it does reduce the efficiency from 88 per cent. to about 70 per cent., rather than believe that there was an error of over 30 per cent. in the measurement of the coal.

But this is only a matter of opinion, and the above is only suggested as an alternative method of getting "reasonable figures" to that given in the article.

B. M. J.

The Magnetic Properties of Asbestos.

The erroneous remarks of Mr. E. Hancock in the number of this journal of October 26th, who seems to have not at all understood the very interesting facts communicated by Mr. C. Swinton in the issue of October 5th, on the magnetic quality of asbestos, induce me to publish my own experience on this matter, which is in accordance with that of Mr. Swinton. It is rather surprising that this behaviour of a substance, now so often used for different purposes, has so long remained without notice, as, besides the magnetic metals, I don't know of any other body that shows this quality in so marked a degree, with ordinary magnets.

Faraday, in his well known researches on the magnetic condition of matter, when employing a powerful electro-magnet, pronounces asbestos as a feeble magnetic substance, and still much earlier, my own compatriot, Brugmans, who was the first to discover the diamagnetic properties of bismuth in 1778, when making an inquiry on the magnetic quality of a very great number of substances, speaks of the asbestos as showing magnetic susceptibility in a high degree, though his magnets, of course, were not very powerful, as compared with what now may be used to this effect; the bars could support at their poles nearly ¾ to 1½ kilogrammes. In his treatise* that has become rare now, he mentions two varieties of asbestos; one kind, with very loose, short fibres, clings to the poles of the magnet, and shows magnetic polarity. The other kind is a more compact substance, with long fibres, and is not so easily brought in magnetic condition; still, it shows this property when supported by a surface of clean mercury, a method which Brugmans applied also in other cases, when a high mobility of the substance in examination was required, and which was very useful to detect the polarity. He also cared for removing any accidental impurity that could have remained on the surface of the substance by exposing it for a time to boiling water.

As for myself, after having read Mr. Swinton's communication, I tried some samples of asbestos I had at hand in my laboratory, which came from Italy. The mineral itself, being very compact, and consisting of long fibres with greenish-white lustre, looking as silk, when placed in a horizontal direction on an axis, moved towards the poles of a strong electro-magnet (capable of supporting a weight of 100 kilos.); but a thread of woven asbestos fibres from another variety, with a somewhat grey colour, suspended before the poles of a permanent steel magnet of moderate strength (supporting 2 kilos. at both poles together) moved directly to them from some distance, and remained fixed just like a piece of iron wire. Still more effectual were small strips cut from asbestos millboard; with a length of 40 millimetres and a breadth of 3 millimetres, they jumped from a centimetre distance to the poles. Having been suspended to a small electro-magnet (supporting 10 kg.), they acquired magnetic polarity, as was evident when brought near to a compass needle; one end attracted the same pole easier than the other, and *vice versâ*. Also when in contact with one of the poles of this electro-magnet, a strip could attract in its turn with the opposed end some fine iron particles, thus behaving as a piece of induced soft iron.

I afterwards got at my disposal several samples from Bell's asbestos warehouse (well known in England) adapted to different purposes, and I noticed especially a kind of grey asbestos paper (millboard) that was highly susceptible to magnetic influence, jumping to the poles of a steel magnet, whilst some samples of asbestos brands had this property not so well marked. I need hardly to add that electric attraction has nothing to do with these effects, as Mr. Hancock supposes, as friction is not applied, and the millboard, even when rubbed, did not show any electric condition. I differ from Mr. Swinton's opinion, ascribing the magnetic property of asbestos to the presence of iron, though this is indeed present, but in *chemical* combination with the other constituents. For the magnetic quantities of the elements often disappear when they are combining. Some iron compounds, indeed, are magnetic, yet very feebly to ordinary magnets, requiring very delicate suspension to become evident, and there are others which, though containing iron, have become diamagnetic; even the very common substance, the oxide of iron, $Fe_2 O_3$, composed of two strong magnetic substances, is apparently neutral, in comparison to asbestos.

To conclude, it would be interesting if one of my readers could give some account on the method of preparing the

* Brugmans's "Magnetismus, seu de affinitatibus magneticis observationes." Lugd. Bat.: 1778, p. 133.

millboard and other forms of asbestos for practical purposes, in order that it may be known if some magnetic substance is perhaps necessarily or accidentally introduced by the manufacturing process.

Dr. L. Bleekrode.

The Hague, *November 5th*, 1894.

It was not my intention to have troubled you with any more remarks, but as Mr. Swinton has caused my remarks to be misrepresented, I should feel extremely obliged if you allow the following to appear :—

It matters little to me what Mr. Swinton thinks me capable of ; when I see statements that I think to be wrong, I shall do my best to get at the truth.

As my opinion differs from Mr. Swinton's, not that it would be any value unless I can prove what I have said, that asbestos is not magnetic. I have not disputed that it can be lifted by a magnet ; if it does contain oxide of iron it is no proof that it is magnetic, as I am not aware that pure oxide of iron can be affected by a magnet. Mr. Swinton speaks of me rubbing a stick of ebonite. If he will take the trouble to read again, he will find I said a thin strip, which will make a vast difference in the results. If Mr. Swinton has wasted his energy on a stick, it is not my fault. I think the following simple, but effective experiments, will enable anyone to satisfy themselves whether asbestos is magnetic, providing it is done as I describe it.

First get a strip of ebonite, 12 inches long, 1½-inch wide, and ⅛-inch thick, then get a small piece of iron, a nail about 2 inches long, and tie a piece of silk round the head and suspend it by the silk that it can swing about, now excite the strip of ebonite with a piece of silk by rubbing, now put the ebonite to the nail, and it will be attracted with considerable force, quite as much as if the ebonite was a piece of magnetised steel.

Now get a strip of cardboard and suspend it like the nail, ½-inch by 2 inches will do, then get a bar magnet capable of lifting the 2-inch nail, now put the bar magnet to the strip of cardboard, and see if any attraction can be got. I don't think there will be any, if there is no sign of attraction it is right, but let the person trying it be quite sure there is not, then put down the magnet and take the strip of ebonite and excite it, which will only require a few quick rubs between a piece of silk, when excited bring it to the cardboard, which will be attracted with force, stroke it two or three times, now take the bar magnet and see the effect, the magnet will now attract the cardboard, but as Mr. Swinton remarked that glass, wood, &c., was not attracted like the asbestos ; but let any other substance have an electrostatic charge, and it will then be attracted like the asbestos, as it is of a silky nature, and its special process of manufacture helps to give it the electrostatic condition.

I might remark that such a strip of ebonite will produce over ¼-inch sparks, and if an incandescent lamp is placed against it when excited, it will become as bright as a vacuum tube lit by a coil giving ¼-inch spark. Lamps with the filament broken make good vacuum tubes.

E. Hancock.

November 6th, 1894.

[Our readers will observe that we have made no attempt to correct the style of Mr. Hancock's letter, lest we might thereby conceal his intended meaning.—Eds. Elec. Rev.]

Design of Large Alternators.

O wad some power the giftie gie us
To see ourscls as others see us.

So sighed Robert Burns, thereby echoing a pretty general aspiration of humanity, a wish often felt but seldom satisfied.

Occasionally, in the course of our national life, we get, as by a sudden rift in the clouds, a gleam of light, which opens to our view a momentary picture of ourselves as we appear to our friends across the Channel or the Atlantic, teaching us more in a minute than we can learn by years of direct study ; such an insight into our character, as seen by others, was granted to us when the first cargo of wooden nutmegs was landed on our shores—it said to us in plain, but forcible language, "You good-natured, kind-hearted and in-shop-keepers-confiding blockheads, buy these and be happy, they are quite worthless, but they look all right."

Our English electrical engineers pride themselves on their keen insight into electrical problems, particularly in connection with the design of dynamos. Other nations may carry on business on a larger scale, but England is the place for science ; great, then, must have been the shock administered to their self-respect when, on last Friday morning, they read the letter signed by your correspondent, Mr. A. C. Armstrong, of the General Electric Company, Schenectady, U.S.A. That letter, though short, contains much ; in fact, it carries a complete cargo of wooden nutmegs. What the original wooden nutmegs said to the English nation, it says to the electrical profession and to the whole race of electric lighting managers, directors, and municipal committees.

With the bone of contention between Mr. Armstrong and Mr. Rankin Kennedy I have nothing to do ; Mr. Kennedy is quite able to take care of himself, but with the gratuitous insult offered to the intelligence of the electrical profession and of the buyers of electrical plant, I am concerned, and with your permission I will saw open some of these logical nutmegs which Mr. Armstrong has sent over to be swallowed whole by your numerous readers. The letter opens with this statement, which is the keynote to all that follows :—

> Coming into prominence as it did after the continuous current machine had attained a commercial success, the alternator has had applied to it all the experience so gained, as well as the ability of mathematicians, so at the present day it is better understood, and can be designed *with a greater degree of accuracy* than the continuous current machine.

This is the confidence trick *à la* Schenectady. No English electrician has yet committed himself to any such sweeping assertion ; on the contrary, it is universally admitted here that alternators are fruitful in surprises.

But your correspondent climbs on to a higher platform—he declares the alternator is no enigma. In effect he says : "I understand it, trust to me, and I will carry you through." Let us see what this highly inflated claim amounts to ; there are at present in this country, I believe, only two alternators which have been built in America (by the General Electric Company, moreover) to a strict English specification (which was modified at their request to meet the possibilities of their construction), but even with the specification so modified, the said alternators do not even approximately comply, notwithstanding that months have been spent in trying to improve them ; but, Sir, it is a matter of common knowledge that continuous current machines can be built even in England to stricter specifications than are ever heard of in America, and that they come out right even on the first test ; but Mr. Armstrong says it is easier to design alternators. We are, therefore, driven to the conclusion that in Schenectady either the continuous current machine is an enigma which their engineers and mathematicians have not yet solved, or that Mr. Armstrong's claim to superior knowledge of the ways of alternators is an empty boast.

After this first application of the saw to the nutmeg, I shall not consider it necessary to deal seriously with Mr. Armstrong's simple unsupported assertions. I will now consider his logic.

The whole drift of the argument—if argument it can be called—is to prove that alternators with iron in their armatures (more particularly the G. E. Company's type) are superior to those without iron (more particularly the Mordey type).

This is excellent ; as I have some interest in the Mordey alternator, I am not going to spoil myself by praising it, but no one can deprive me of my pleasure in hearing other people run it down. It is the only alternator that anyone takes the trouble to speak ill of.

To return to Mr. Armstrong's argument, I find he particularises his admiration of the ironclad alternator thus :—

> Breaking the field of a machine of this class need not throw it out of step.

Nevertheless, it does. Mr. Armstrong need not have written his letter ; nevertheless, he did.

> The fields of two ironclad machines running in multiple can be varied within wide limits without interfering with their keeping in step.

Quite so ; they will not keep in step unless the fields *are*

varied. In fact, under some conditions, the field current in one must be twice the strength of that in the other.

Now, if Mr. Armstrong says things like these about the alternators which he does understand, which he says are no enigma to him, what will he say about the disc armature machines which he does not understand? He says this:

> A disc armature machine will have a very strong synchronising power when running in multiple (parallel), but if from any cause the field current of one machine becomes broken, the sudden rush of current through its armature from the others will be enormous, and will either burn it out or wrench the conductors from their frail support, as has been proved in practice.

Now, there are only two types of disc armatures in use. If this refers to the Siemens type of machine, it is not true, because they have not a very strong synchronising power, and if it refers to the Mordey machine, all I can say is there are 350 of these machines in daily use, and the sad results described have not yet taken their places on the page of history—not often, not once!

Then follows:—

> These machines require very close regulation of the field current to prevent large cross current, and also a possible dropping out of phase.

Your readers know perfectly well that the truth is exactly the reverse; that the Mordey machine, which is the one aimed at, requires no attention to individual fields. In fact, they give fairly good lighting with no regulation at all, and not one has ever yet dropped out of phase. We shall certainly hear of it when it does. After a few more statements of the same type, we come to the conclusion:

> It is evident then (therefore) that the machine which will give the best satisfaction in practice is the one having a fair amount of armature inductance.

I have tried my best to discover the use of the words, "It is evident, then," but I cannot, for the life of me, see any use in trying to draw a logical conclusion from false premises. Mr. Armstrong piles up his "logic" in deprecation of low armature inductance, but this, with low resistance, is the distinguishing feature of the modern continuous current machine, in which, also, the great difficulty has been to get a good mechanical drive for the conductors. Nevertheless, they are universally worked in parallel, and are all theoretically subject to the disasters which Mr. Armstrong has so graphically but incorrectly described. Nevertheless, they work well, and, as Mr. Armstrong puts it, this time correctly, "They have obtained a commercial success."

I now come to the prize nutmeg:—

> As a further argument in favour of ironclad construction, and one that will be truly appreciated by commercial men, I would point out that there are on the market to-day but one or two types of machines using armatures without iron where there were a number a few years ago.

Now, Sir, I have always understood that to a commercial man one fact is worth half-a-dozen opinions, and I think that the true facts in this instance ought to be quite as well known to Mr. Armstrong as they are to me, for if the alternator itself is no enigma to him, we may reasonably expect him to be well up in its history.

I have been intimately connected with the use and construction of alternators for 16 years; during the whole of that time only two types of alternators have appeared without iron in their armatures, viz., the Siemens and the Mordey (the Ferranti alternator is strictly Siemens). Both these types are alive to-day, and both are being made by their original constructors in larger quantities than at any previous date. They also outnumber other kinds manufactured in England two to one.

Following this wooden nutmeg is half a column of technicalities, which the ordinary electrical student will dispose of in two minutes, and the letter concludes with a statement which is, if anything, less correct than that which I have quoted and exposed above. It is valuable, however, as showing that the whole letter, instead of being, as it pretends to be, a critical essay, is simply a common trade advertisement of the General Electric Company.

John S. Raworth.

P.S.—I have learned by experience that letters to the Press are often carelessly read, and their object consequently misunderstood. In the selection of an alternator everyone has a right to his own opinion, and I have no desire whatever to act as a buffer between Mr. Rankin Kennedy and Mr. Armstrong; the sole object of my letter is to call the attention of your readers to the quality of the rusks and milk with which the latter gentleman proposes to feed the electrical infants of this country.

Mr. Armstrong presents his views on this question from a transatlantic standpoint, and, therefore, his statement, which he thinks will have much weight with commercial men, namely, that there are few machines made without iron in the cores is one which applies, strictly, to America only. On this side this class of machine is made by the most important of firms—Siemens Bros., Brush Company, Ferranti, Crompton—and more of them are in use than of any other type.

Then, as to costs, there can be no comparisons made between costs in America and Europe. Protection has to be paid for in America, and this governs cost there, while it does not enter into costs here at all.

Then, in comparing the two types of machines, Mr. Armstrong makes a great mistake in taking cast-iron as the material used in solid field-magnets; this material is used only as the framework, and the best soft iron is always used for the cores and poles, and I have not yet heard of the laminated iron which can be worked at any higher induction than good solid soft iron.

In this country laminated field-magnets cost at least double that of field-magnets made of soft iron cores and poles, and some designs cost as much as thrice that.

To compare laminations with cast-iron is absurd. Lamination must be compared either with solid soft iron of best quality or the softest cast steel—which is not more than 10 per cent., at most, below laminations in permeability and susceptibility.

In discussing the leakage question Mr. Armstrong does not distinguish clearly between armature and field-magnets. Has he never seen ironclad fields on flat coreless armatures? It would be interesting if he would just show where field leakage can possibly occur in an ironclad field, say, of Mordey type. I have never been able to discover any, while in radial poles built of laminations I have measured leakages ranging from 25 to 50 per cent., and these figures are quite common.

Eddy currents exist in all dynamos however built, and practical experience proves that in the flat ring coreless armatures they do not exist, either in the armature conductors or in the solid soft iron poles, to any greater extent than they are found in the huge laminated structures in other machines.

On this side we believe in field strength and weak armature reaction. Machines built in that belief behave very different to machines with weak fields and strong armature reactions. Many designers seem to believe that the field coils are designed to magnetise the field cores and armature cores only, and leave out of sight the primary object, that is, to thread in and out the greatest possible magnetic induction through the generating coils.

Now, as to the question of synchronising, I hold that one machine is as good as any other for synchronising working from electrical points of view, and I believe the inductance of the armature has nothing whatever to do with the question. If inductance is any advantage, it can be got by placing induction coils anywhere in the circuit, at a much less cost and in a more rational manner than providing for it in the armature.

Mechanical momentum has more to do with the question of synchronising, for, if two machines are run together in synchronism, one with great momentum and the other with little momentum, and the external circuit short-circuited, the one with little momentum will fall out of step every time. This experiment can be made with two machines and a fly-wheel which can be put on the shaft of either. The accident, referred to by Mr. Armstrong, was due to the difference of momentum between the two machines. I place no importance on the synchronising question; any electrician, who knows his business, ought to be able to synchronise any alternator without the slightest hitch, year to year, and that whatever their construction may be.

As to mechanical strength, I grant at once that the coils are better protected in laminated structures, but I deny altogether that coreless armatures cannot be made sufficiently strong for all practical purposes. We have only to consider that hundreds of them have been at work for at least ten

years. I work now with one, sometimes, which has had the roughest of usage for more than ten years, and has never required repair.

The strain on a commercial coreless armature machine is always provided for with a sufficient factor of safety.

Finally, a coreless armature and an ironclad field of best soft steel, say, of Krupp's make, or of some of the little known soft steels made about Sheffield, can be made for just one-half the cost of a radial pole machine with laminated cores, for the same output at same speed, and the coreless one will weigh less also.

The exciter, which is always lost sight of in its insignificance, is really the weak spot in the alternator; most of the trouble arises from exciters in synchronising. We must never forget this small but very important exciter, it is the heart of the great giant alternator, and the least trouble there is nearly always fatal with any kind of alternator.

I am fully convinced that not only is the coreless armature superior for alternators, but also that the future will see all large continuous machines made also with coreless armatures, *a la Desrosier*. Lamination in large machines will become a thing of the past.

Rankin Kennedy.

Regulation of Pressure on Supply Mains.

I do not think you quite grasp the situation when you say that there is "something radically wrong" in a system which is effected by switching on a 50-ampère arc lamp.

In the first place, during a heavy load on a station the switching on of a 50-ampère load will not cause any trouble, but during the day, in bright weather, many large stations do not have more than 100 ampères going out on each side of a three-wire system, and very often less. A 50-ampère motor being started means an increase of 50 per cent., and it must take a fraction of a second for any engine governor, or even battery, to take up this extra percentage, besides making it necessary to slightly increase the terminal volts, which must be done by the switchboard attendant.

However, the switching on of a 50-ampère motor really means a rush of current for a moment of nothing less than 100 ampères, or 100 per cent. of the current being generated.

You must see from this how very necessary it is for motors or large arc lamps to be switched on through a resistance.

C. O. Grimshaw.

November 7th.

Localising High Resistance Faults in Submarine Cables.

Might I point out a punctuation error which appears in my last letter in your valuable journal, as it somewhat affects the context. The sentence commencing on the 19th line should read, "Again, Mr. Jones justly expresses solicitude for his standard cells, but with simple precautions, what greater objection is there," &c.

Thanking you in anticipation,

F. Alex. Taylor.

Having read all the articles and correspondence which have appeared of late on this subject in the ELECTRICAL REVIEW, we were requested by Prof. Jamieson to take the "Sir John Pender Tank" of submarine cables core, connected with this laboratory, and try the several methods described on an actual fault, which was inserted about 100 ohms from what would have been the shore end in a submarine cable.

A test was made of the comparative merits of Mr. Rymer Jones's "*null condenser method*," and the method described in "Munro and Jamieson's Pocket-Book of Electrical Rules, &c.," p. 152.

We found that about 50 per cent. more time was taken by us to connect up for Mr. Jones's method (see fig. 2, p. 280, ELECTRICAL REVIEW), than for the "*old zero method*" (see M. and J., p. 152).

The time actually taken in making our tests by the two plans was about the same, and there can be no doubt that where "earth" or "fault" currents are present, or where very high resistance slides cannot be obtained, the "*null condenser method*" is preferable.

For accuracy, the two condensers used must be of the same make and material, though not necessarily of equal capacity. We found that no reliable results were obtained when the dielectrics of the condensers used were of different materials, and thus had different rates of absorption or electrification. Further, the greatest care must be taken in, first of all, seeing that the condensers do not leak.

Finally, we found that the "*old null method*" (M. and J., p. 152, and fig. 3, p. 281, ELECTRICAL REVIEW) gave results in our case about 2 per cent. nearer the actual position of the fault than the condenser methods described by Mr. Jones for finding P, p, and p^1. We very much preferred the null methods to that of discharges from a condenser.

C. B. Cruickshank, M.A.,
J. Francis S. Scott,
Electrical Engineering Students.
The Glasgow and West of Scotland Technical College,
Electrical Engineering Laboratory, Glasgow.

Electric Lighting at Folkestone.

Whilst the letter from Mr. Medhurst, which appeared in your last issue, forms very amusing reading, it is somewhat puzzling when one endeavours to determine whether impudence, ignorance, or bad taste constitutes its predominant element. Mr. Medhurst's previous attempt to justify his position at Folkestone having proved a dismal failure, he wisely foregoes all further attempts in that direction, and contents himself by seeking shelter behind Mr. Councillor Baker. With reference to the last mentioned gentleman, I have nothing to say at present. Since, however, Mr. Medhurst has identified himself so closely with Mr. Councillor Baker, one is perfectly justified in assuming that the motives, views and opinions ascribed to the latter, are endorsed by the former.

Mr. Medhurst now practically contends that he is perfectly justified in his efforts to frustrate my work at Folkestone, (1) because I "recently carried on business as a photographer at Sandgate," (2) because I am not a member or an associate of either of the three engineering institutions, and (3) because he could scarcely recognise me as belonging to his profession.

Now, supposing that I "had recently carried on business as a photographer at Sandgate," what of it? The fact that Sir Charles Wheatstone, who commenced life as a musical instrument maker, was for many years the principal member and leading spirit of the Photographic Society, did not prevent him inventing the dynamo, the Wheatstone bridge, and many other useful electrical appliances, as well as the English concertina. Nor did the fact of Joseph Wilson Swan being deeply engaged in practical and commercial photographic work the greater part of his life, prevent him inventing and perfecting the manufacture of the carbon filament incandescent lamp. Whilst it is true that I took a photographic business at Sandgate as a speculation in 1885, I was not a photographer, but employed one to manage the business for me. I relinquished the said business in less than two years, consequently Mr. Medhurst's "recently" represents a period of 8 or 9 years ago. At the time I took the Sandgate business I was not only an engineer—having served a seven years' apprenticeship—but had actually had some nine years' practical experience in electric lighting work. During the time I was at Sandgate I did a considerable amount of engineering work, including the design, &c., of the Chatham, Rochester, and District Electric Lighting Company's Works, which I subsequently (1887-8) laid down at Rochester and Chatham. At the time I erected the Rochester central station, I believe that the total number of similar undertakings in this country, including the Metropolis, was seven. Since leaving Sandgate I have been exclusively employed in electric lighting work.

Having demolished Mr. Medhurst's photographic scarecrow, I will, in very few words, dispose of the "Institution" question. Out of pure consideration to Mr. Medhurst, it is expedient that I should first of all eliminate two out of the three associations to which he refers, which will leave me with only one to deal with, *i.e.*, the Institution of Electrical Engineers, of which Mr. Medhurst has been a few months a

proud member. Membership in the said Institution is no guarantee that a man is either an electrician or an engineer. If membership proves nothing, non-membership must prove even less. With reference to myself, the fact that when the electrical trades section of the London Chamber of Commerce was formed in 1888, I was elected a member of the first working committee as a representative of the then existing electric lighting undertakings, without any seeking on my part, clearly proves that in spite of Mr. Medhurst's contention, I have occupied a recognised position in the electrical world for several years, possibly dating back to a period prior to Mr. Medhurst even directing his serious attention to electrical matters.

The final paragraph of Mr. Medhurst's letter is most significant, indicating, as it does, the *morale* of the writer, which the public will not be slow to appreciate.

The representations made by Mr. Medhurst's friends at Folkestone, to the effect that that gentleman is a recognised eminent authority, will possibly amuse the majority of your readers, who have doubtless been already surprised at the enormous amount of work which his friends have asserted—in support of his candidature for public favour—that he has actually carried out. I do not, however, dispute a single word of the latter claim; but since Mr. Medhurst has, without the slightest warrant of justification, questioned my professional status, I claim the right in return to challenge him to name the five or six London vestries to whom he is consulting engineer, and also to state what electric lighting work, if any, he has actually been responsible for at St. Petersburg, Lyons, Barcelona, Shrewsbury, Devonport, and Wigan.

Mark Parker.

Rochester, *November 6th*, 1894.

I note in your issue of the 2nd inst. that a correspondent states that Mr. Medhurst was presented to the Folkestone Corporation as consulting engineer to Cambridge, among other places. As engineer and manager of this company, I beg to say the statement is entirely incorrect. Mr. Medhurst was for some time on the staff, and had charge of the station for about three weeks at the commencement of running; his resignation was accepted in December, 1892, and he has since had no connection with this company.

John H. Barker,
General Manager the Cambridge Electric Supply Company, Limited.

Standards of Electrical Measurement.

I notice in your interesting article of last week on "Standard Units for Electrical Measurement," a curious misapprehension regarding the possible effects of the ground, originally a morass, under the foundations of the Board of Trade Electrical Laboratory in causing unsteadiness of the building, according to which it is supposed that there may be an "elastic vibration of the house as a whole due to this," and sufficient to cause stretching of the ligaments of my electro-dynamic balances. No such effect could be produced unless the vibration of the table on which the instrument is placed were much more than enough to cause the ink to jump out of an ink-bottle placed beside it on the same table.

The balance beam of every instrument is loaded by the maker with a heavy weight, which is kept on for two days and a half after the soldering of the ligament has been completed. The weights used are from 4 lbs., the least, up to 56 lbs., the heaviest, according to the calibre of the balance. It is found that after this severe *aging* of the ligament, there is no sensible stretching afterwards in regular ordinary use for years. In some cases a slight stretching has been found as the result of long continued heating by a strong electric current. The sighting at the two ends of the beam makes it impossible that any elongation, that could vitiate the accuracy of the instrument, could pass unperceived, and means are provided in the instrument for readjustment in any case in which perceptible stretching has taken place.

Kelvin.

University, Glasgow, *November 7th*, 1894.

NOTES.

Electrical Symbols.—A correspondent writing regarding what appears on page 519 of our last issue, says:—"I have reason to believe that Mr. Carl Hering wrote the leaderette in the *Electrical World* to which you properly take exception. In the same issue as that in which it appeared, a notice, couched in similar terms, was included in the 'Digest.' As Mr. Hering is one of the fathers of the symbols which were issued by the *Electrical World*, a paper where his influence is supreme, does it not look like a one man reply to Prof. Jamieson? I am quite sure that Prof. Jamieson may be trusted on such a subject as nomenclature; his experience as a teacher and as the responsible author of *the* pocket-book are of great value in this connection, while I can myself vouch for the great value of his very clear ideas as to what is easy and what complex. As a guide to students, his lectures are of more value than most, owing to their lucidity, and one carries away a system of 'method' after being with him a year or two."

Wanted a Wire for High Temperatures.—We have had the following interesting query put to us:—"Can you tell me of a wire, the insulation of which will stand a constant dry heat of about 300° F., and at the same time comply with the supply company's requirements as regards insulation resistance. I have tried both pure and vulcanised rubber covered wires; in pure rubber, the rubber simply soaks into the cotton braiding, which then gradually burns or chars as it were, and is easily rubbed off. Vulcanised rubber is nearly as bad, but behaves a little differently, according to the maker; some kinds become pappy in about a week, the rubber oozing partly through the braiding, whilst other makes simply dry into dust. The wires having to be renewed about every two years is a considerable expense, and should feel glad if I could get a wire that would last if only for five or six years."

Regulation of Pressure on Supply Mains.—We extract the following from the letter of a friend:—"You seem astonished to find that 50 ampères make a difference to station supply. Now, as a matter of fact, I can give you two cases I know of. In X—— in testing meters I had to be *very careful*. If during the winter, when 2,000 to 3,500 ampères were going out, I put on a meter circuit taking 60 or 80 ampères, down went the pressure 5 or 6 volts. Also I know that at Deptford they never could make out why London customers growled about the steadiness of supply being poor, until they found out that meter testing was going on at Adelphi Terrace. X—— could not stand a sudden change in load of 50 ampères without the town lights showing it, and being corrected for by hand regulation on the machines; and, I believe, the same applied to Deptford."

Society of Arts.—The arrangements for the 141st session of the Society of Arts are now announced. It commences on November 21st with an address from the Chairman of the Council, Major-General Sir John Donnelly. The first regular paper of the new session will be by Mr. Hiram Maxim, on his "Experiments in Aeronautics," and this will be followed the succeeding week by one by Mons. Hermite, on "The Electrical Treatment of Sewage."

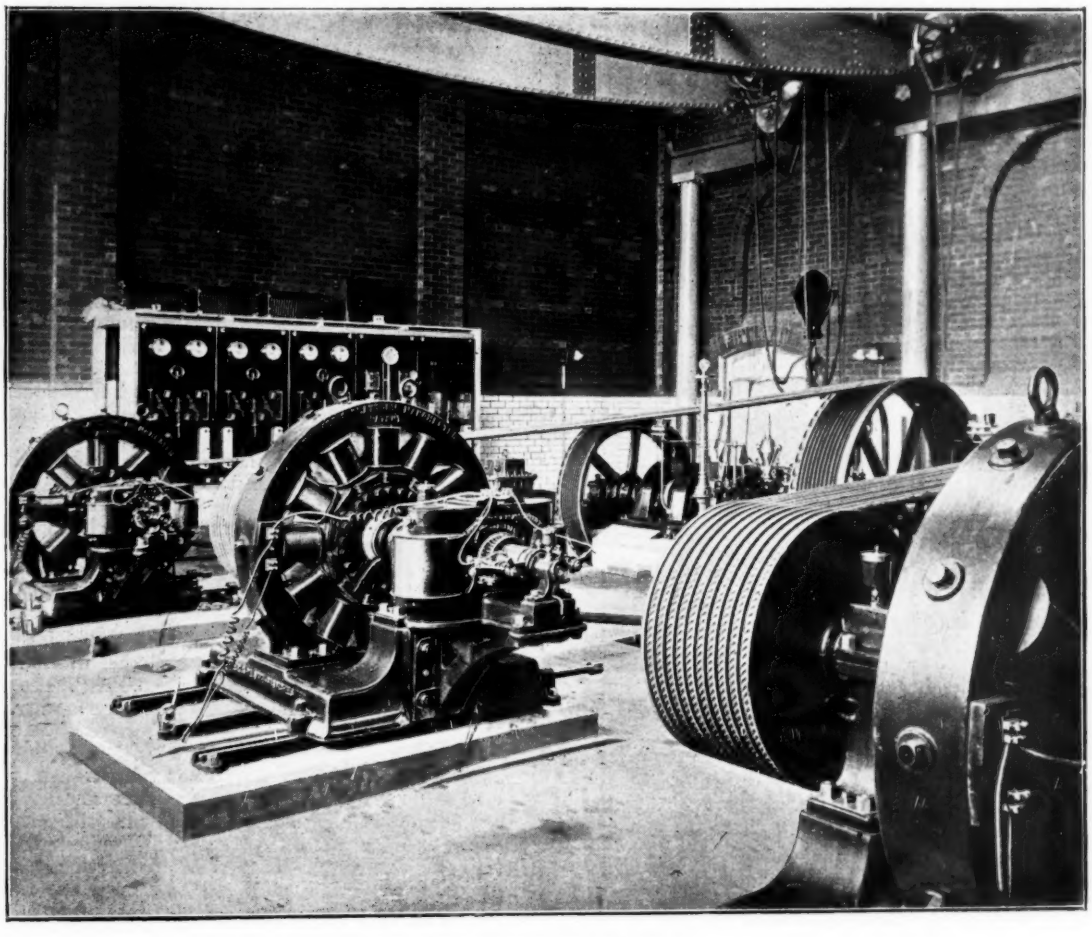
Electrically Controlled Clocks.—A scheme for the establishment throughout the city of Glasgow of a system of standard time by means of electrically controlled public clocks, regulated every second from the stellar clock at the Greenwich Observatory, is receiving consideration at the hands of a committee of the Town Council. Prof. Becker is being consulted by the committee.

Institution of Civil Engineers.—A branch of the Institution of Civil Engineers has been formed at Leeds. The Association is to meet once a month for reading papers and holding discussions. The inaugural dinner of the Association was held on Saturday evening last, Sir James Kitson presiding.

[*Continued on page* 564.]

TWO LANCASHIRE CENTRAL STATIONS.

It was once said that what Lancashire thinks to-day England will think to-morrow. This saying, however true a significance it may have had politically at the time of its birth, is not altogether true of electrical work. They have their own ideas down Lancashire way about steam engines, and if one says that they are unsuitable for electric light work, the chances are that he will have a bad time of it. Not that one can consistently grumble at the progress that has been made in the county; in fact, we suppose there is not a shire in the country which has so many stations erected, or in course of construction, as Lancashire. The names crowd upon one fast enough—Liverpool, with its well-tried system and wonderful economies, Manchester, replete with modern ideas, Preston, Oldham, Blackburn, Morecambe, Lancaster, Nelson, Blackpool, Salford, Burnley, Prescot, are practically all equipped with systems. The latest Lancashire towns to embark upon electric supply are Bolton and Southport. Neither of the systems offer any special development in electricity works, but they are good specimens of substantial stations, not suffering from electrical embellishments, and remarkably free from fads.



View of Southport Works.

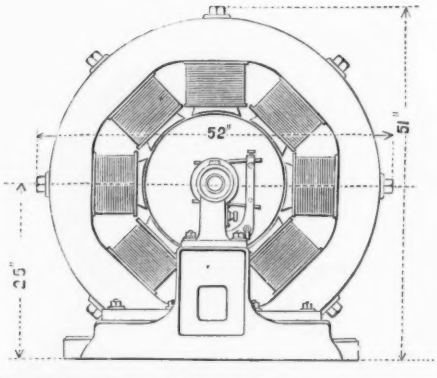
THE SOUTHPORT ELECTRICAL WORKS.

We have no desire to say much about Southport itself. Its history and its characteristics will be, no doubt, considered elsewhere. Briefly, it is a thriving once-upon-a-time seaside town, patronised largely in summer by visitors, but maintaining a large resident population all the year round. The streets are remarkably fine, and the shops handsome and imposing. In fact, the size and character of the town point unmistakably to electric lighting being readily adopted. Indeed, what surprises us most is that the Corporation have been in the first instance satisfied to put down plant of such moderate dimensions. The works are excellent, but they strike one as being extraordinarily small, considering as we do the undoubtedly favourable conditions which exist. To adapt a saying to our own use, we may say that happy is the municipal authority that has no electrical history. True it is not always the case, for we know of towns that have no history but are far from happy. Southport municipal electric lighting has a history, not a remarkable one nor a lengthy one. The committee for electric lighting went through various phases before they ultimately determined on the present plant. It is not, however, necessary to dwell upon the historical aspect of the question, so we will pass on to consider the plant.

The works, which have been built on spare ground adjoining the gasworks at Blowick, are a considerable distance from the centre of the town, the length of the feeders to the first sub-station being 2½ miles. A high pressure alternating system was the only practicable one to use for Southport, but the distance of the works from the centre of the area is rather great, even for a high pressure system. From the station to the transformers the mains pass through a comparatively poor district, or, at any rate, one from which a demand for current could scarcely be expected. We appreciate the desire of the Corporation to utilise ground which they already possess at Blowick, near, as we have already said, to the Corporation gasworks, but we should have thought that to have erected the works on land much nearer town would have presented greater advantages. These are one or two points that strike one in a cursory examination of the system. The question is simply whether it would have been cheaper to erect a station nearer town, or use a longer main,

and utilise ground which costs very little. We have not the slightest doubt, however, that the Corporation have carefully considered this question, and that the advantages of placing the works at Blowick are greater than could have been obtained by any other arrangement.

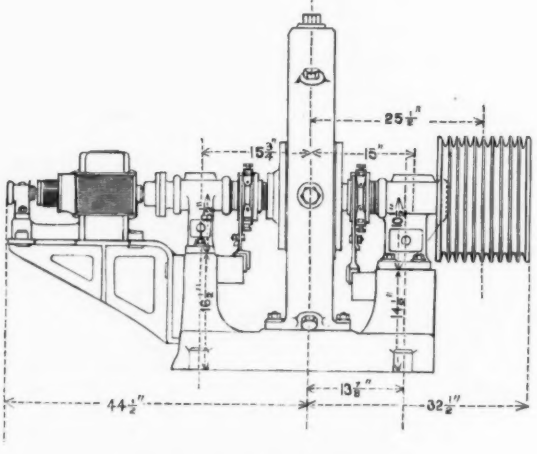
Of the works themselves we have nothing but praise. They have been laid down on good lines, they are exceedingly compact, and the complete arrangements of the interior are excellent. Our only regret is that the Corporation did not see their way to erect more machines, for we feel sure that the demand will soon exceed the supply. When the Council comes to consider the matter of further extensions, we would respectfully urge upon their notice the necessity of considering the question of street lighting. Southport possesses promenade and streets which would well repay being lighted by electricity.



End Elevation of Mather & Platt Alternator.

The station does not comprise anything which is essentially new in principle. It possesses, however, two or three minor novelties which merit some notice.

As we have already indicated, the system is a 2,000-volt alternating with transformer sub-stations. The alternators are rope-driven by compound horizontal engines made by Browett, Lindley & Co. Two of the engines are of 100 H.P. each, and one of 55 H.P. Of the alternators, two are of 60 units capacity each. These machines have a periodicity of 50 per second at 500 revolutions per minute. The third alternator, driven by ropes from a 55 I.H.P. engine, gives an output of 12½ ampères at 2,000 volts, at a speed of 750 revolutions per minute. This machine has 8 poles, whereas the two larger ones have 12 poles. Thus the periodicity of all is the same, viz., 50.



Side Elevation of Alternator.

The type of alternators used at the Southport station is by no means new, but it has not been extensively employed in English central stations. The view of the interior gives an excellent impression of the machine, and further details may be gleaned from the detailed drawings. It will be seen that the armature revolves and the magnets are fixed. The magnets are wrought-iron, and are arranged round the armature, exterior to it, and are attached to a massive cast-iron ring, which forms the yoke connecting the limbs. The attachment is so arranged that any of the magnet cores can be removed without disturbing the remainder, or taking out the armature. The armature is constructed of two plates or discs keyed on to the shaft, between which the armature cores are held by bolts, so that, as with the magnets, any section of the armature can be removed without disturbing the remainder. Apertures in the discs allow free ventilation in the interior of the armature cores.

The magnets are excited by a Mather & Platt's "Manchester" dynamo, which is carried on a bracket bolted to the bedplate of the alternator, the armature shafts being coupled direct. The whole arrangement is exceedingly compact, occupying little floor space.

The exciters connected with the two larger machines are each for an output of 100 volts 25 ampères, and that connected with the smaller machine for 100 volts 15 ampères. They are of Mather & Platt's patent "Manchester" type. The exciting current required for the full load of the larger machines is 5·75 ampères, and for the smaller machines 4 ampères. Thus any of the exciters are sufficient for exciting all three machines.

It will be observed that the machines require exceedingly small exciting power, which results in a very high electrical efficiency: with full load this exceeds 97½ per cent. for all three machines.

It is a noteworthy point in connection with these machines that they may be short-circuited without detriment. The current passing through the armature, if absolutely short-circuited with the fields excited to their full extent, is less than double the normal output of the machine, which it is stated would not be injurious for a short time.

The machines are manufactured by Messrs. Mather and Platt under the patents of Dr. John Hopkinson and Dr. Edward Hopkinson.

As we have already said, the engines are of the horizontal high speed compound type; two of them have cylinders 11 inches and 16½ inches diameter, with a 12-inch stroke. They run at 180 revolutions per minute, and indicate 100 horse-power each. The crankshaft is 5 inches diameter, and extends beyond the fly-wheel to an outer pedestal bearing. The fly-wheel, to centre of ropes, is 6 feet 8 inches diameter, and is grooved for 10 1-inch ropes.

There is a similar engine, having cylinders 8½ inches and 12½ inches diameter, with a 10-inch stroke, which runs at 200 revolutions per minute, and indicates 50 H.P. The crankshaft is 4½ inches diameter, extended with outer bearing. The fly-wheel is 5 feet 4 inches diameter, to centre of ropes, and is grooved for 8 1⅜-inch ropes.

The engines are fitted with piston valve to high pressure cylinders, and flat slide valve to low pressure cylinders, a Porter governor controlling speed of engines by throttle valve. The bearings are of gun-metal, lined with white metal, and Abercrombie's patent ends are fitted to the connecting rod bolts. The governor is adjustable by hand whilst running. The lubrication is continuous, oil being taken from a central oil box, and conducted down tubes to the various bearings. Sight feed lubricators are fitted to the cylinders.

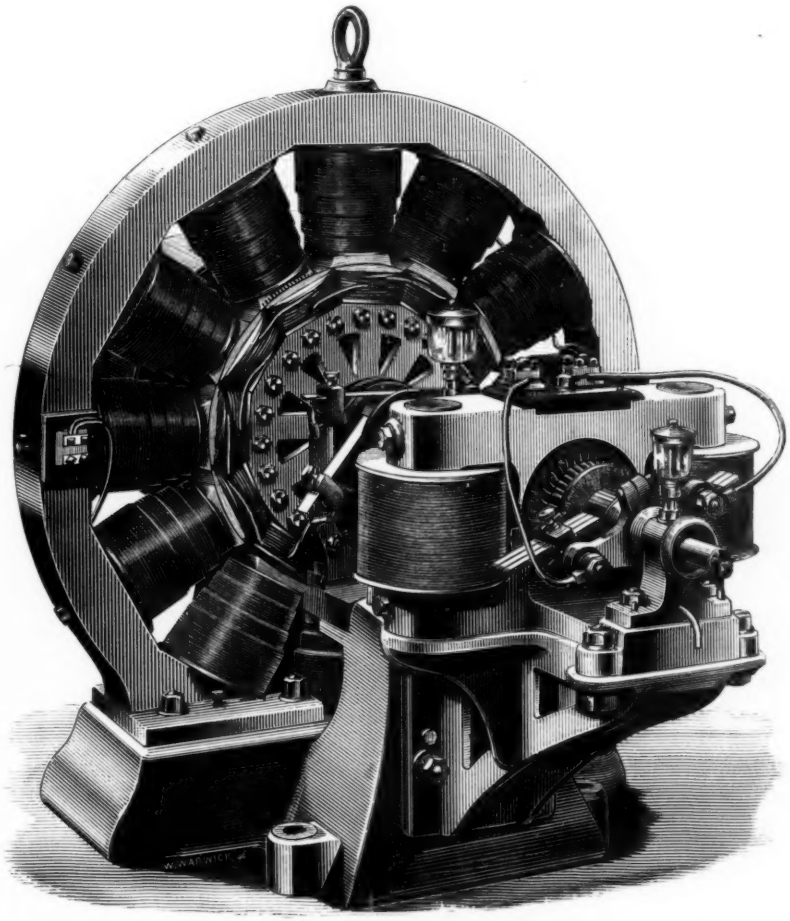
The details of these engines generally are similar to the standard vertical type, which with Messrs. Browett & Lindley are so prominently associated; but they were specially constructed in horizontal form, to conform to the engineer's specification.

The switchboard, which is arranged on a platform on one side of the engine and dynamo room, consists of five panels, one for each of the alternators and exciters, and also one for the circuit board, and a fifth panel for the synchroniser. Each alternator panel carries a double-pole main switch and ammeters in the exciting and main circuit, also two main cut-outs. The circuit panel is also provided with a double-pole main switch, double-pole cut-out, recording voltmeters, and ampèremeter. The synchronising panel is provided with a Cardew voltmeter of vertical type, together with switches for throwing the machines into parallel.

The switchboards and instruments have been designed and supplied by Messrs. Mather & Platt, Limited, Salford Iron Works, Manchester.

A 10-ton crane, made by Isles, Limited, traverses the station.

In the boiler house are two Lancashire boilers of 400 H.P. each, made by the Oldham Boiler Company. They call for no special mention; they work at a pressure of 125 lbs., and are fired by hand. A Tangye feed pump and a Berryman feed water heater are used.



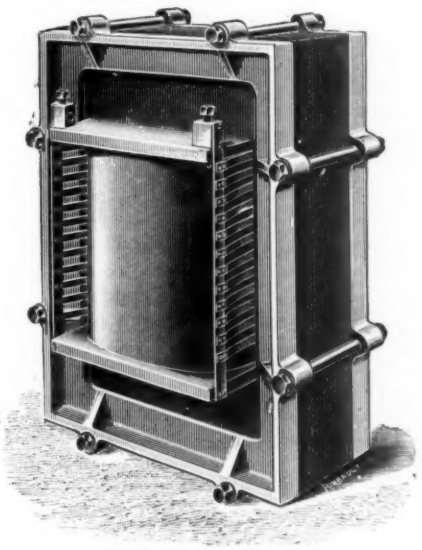
View of Alternator with Exciter.

Distributing System.

High tension cables run from the works to the sub-stations. They are armoured concentric with paper insulation and laid directly in the ground; they are made by the British Insulated Wire Company. The feeders are of 19/14 section. It may be mentioned that the makers had to comply with an extremely stringent specification, the conditions of which, however, have been satisfactorily fulfilled. Samples cut from the cable were tested by the Southport engineer, with a potential difference of 20,000 volts alternating. The whole cable had to be tested at the makers' works for an hour, with an alternating current of 10,000 volts pressure, and again with a pressure of 5,000 volts, after being laid and jointed up complete. Jointing and disconnecting boxes were tested to 15,000 volts. The whole of these tests were carried out without the slightest mishap. There are five sub-stations, each containing a 25 H.P. transformer made by Siemens Brothers.

The transformers are of the latest design, and consist of a primary and a secondary winding enclosing the middle limb of a double magnetic circuit of laminated iron. The output from the secondary circuit of each transformer is 18·75 kilowatts, with a frequency of 50 complete periods per second, the ratio of transformation being from 2,000 volts to 100 volts.

The construction is somewhat as follows:—The core is built up of special stampings of very thin charcoal iron of the best magnetic quality. These stampings are built up into a double magnetic circuit of three limbs by inserting the stampings into the finished winding; the whole is securely clamped together by means of two strong castings bolted together. The winding is on a substantial bobbin, the body of which is made entirely of insulating material and the cheeks of wood. The material is of a specially tough character, which will retain its mechanical and insulating properties at the highest temperature to which the transformer can rise when running continuously at full load. In the high tension coil a layer of this same material is inserted between successive layers of wires. The winding consists of



Siemens's Transformer.

turns of high conductivity copper wire, either double cotton covered or taped according to the size of the conductor.

The high tension terminals are insulated from the wooden cheek of the bobbin by ebonite. The low tension terminals are mounted on the wood.

The cable used for the low tension network is of Siemens's CN type, with conductors each 0·3 square inch section. The inner conductor is insulated with specially treated fibrous material, covered with the outer conductor, insulated again, lead-cased, and sheathed with steel bands.

The Demand.

We understand that the Corporation have received more applications than they will be able to meet. This is very satisfactory, and ought to convince the Council that electric lighting is more popular than they supposed. The demand is equal to 4,800 8-C.P. lamps and 24 arcs. Street lighting is not contemplated at the moment, but two lamps are to be erected in the streets for experimental purposes.

The opening ceremony takes place to-day, when the Mayor will formally switch on the light. It is to be recorded to the credit of the engineer, Mr. Arthur Ellis, and the contractors, that the whole of the work was practically complete a week before the time fixed for the opening, and on the occasion of our visit a week ago, the engines and dynamo were running exceedingly well.

Summary of Southport Electricity Supply.

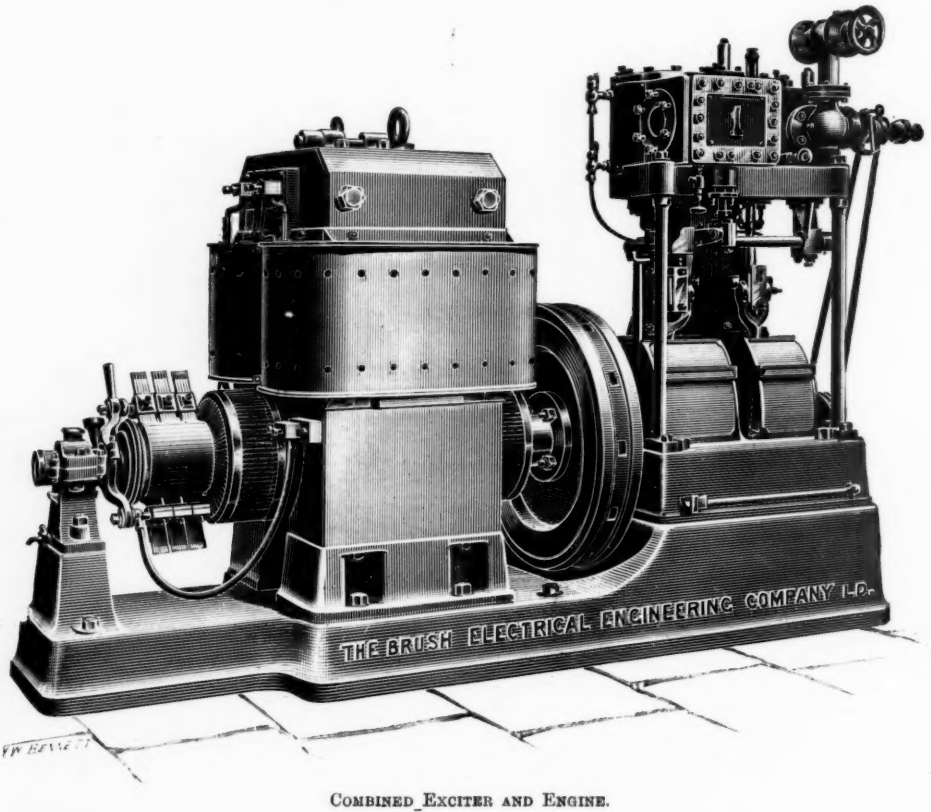
System.—Alternating current generated at 2,000 volts, distributed through low tension network by means of five transformer sub-stations. Alternators have revolving armatures, and are made by Messrs. Mather & Platt. Engines of high speed horizontal type, made by Messrs. Browett and Lindley. Steam raising plant: Lancashire boilers fired by hand. Capacity of plant erected, 150 units.

BOLTON ELECTRIC LIGHTING.

Like the system just described, the Bolton Corporation supply works do not involve any radical departures from existing methods of generation and distribution. There are some distinctly novel features of minor importance, but the exigencies of patent law may preclude more than a passing reference.

A noteworthy feature about the Bolton system is that it has been completely carried out without the aid of a consulting engineer. There is a good deal to be said in favour of an arrangement under which the engineer who is to run the plant has a voice in the choice and erection of it. The one objection is that the opinion of a salaried official may not carry the weight of an outside professional man. If a council were reasonably constituted it ought to do, for resident engineers are, as a body, less interested in patents and special systems than other engineers.

The Corporation of Bolton considered the question of electric lighting at a fairly early period. They, in fact, obtained a provisional order in 1890 or in the early part of 1891. Before deciding finally upon a system, a committee of the Town Council visited several electricity stations having special reference to their own proposed works. It was resolved to borrow £40,000, and on August 2nd a Local Government enquiry was held. With characteristic expedition the Local Government Board, after two months had elapsed, gave their consent, and shortly afterwards the work was commenced.



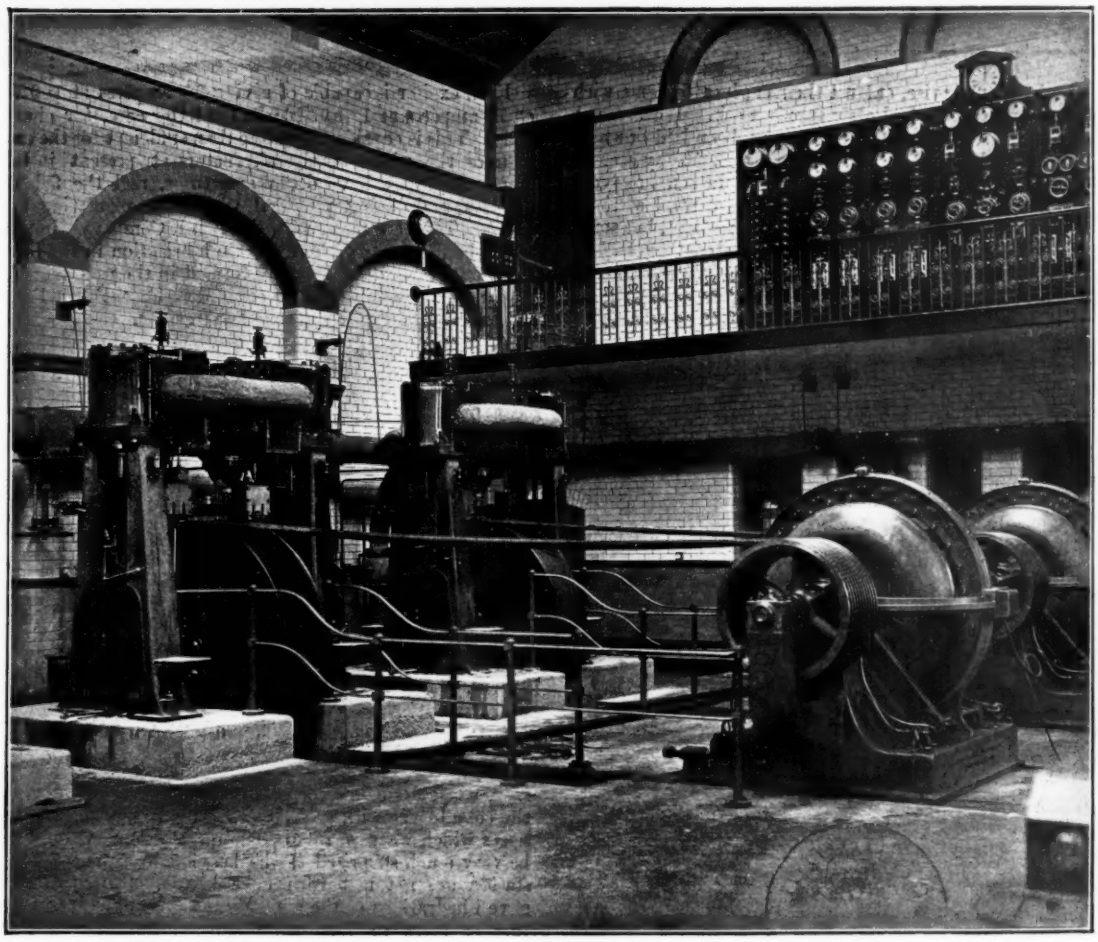
Combined Exciter and Engine.

The System.

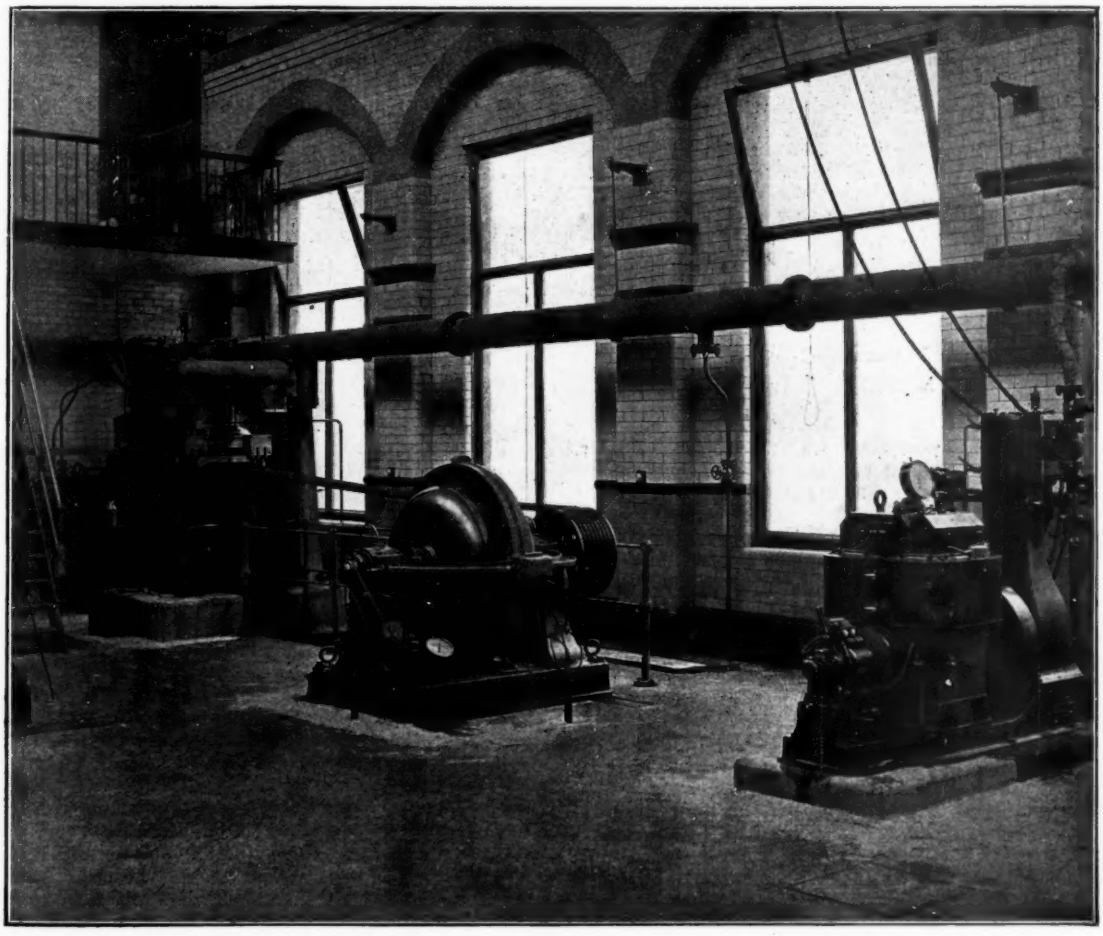
The system which has been adopted is an alternating high pressure one, with low tension distribution from transformer sub-stations. As is generally the case, the system admits of modifications in the way of occasional house transforming. The works are situate on an edge of the town, though not more than three-quarters of a mile from the centre. They adjoin the gas works, and will not be stinted for land when extensions become necessary. The building is much after the usual type of central station erections, neither too ornate nor monotonous in design. The site of the works is most convenient and are provided with sidings to the Lancashire and Yorkshire Railway.

Engines and Alternators.

The Town Council were apparently convinced that it was unnecessary to go outside Bolton for engines. It must be admitted that some of the finest engines in the world are made here, and it is to the credit of the Corporation that they desire to support home industries, but the danger under such circumstances is that they might, in their anxiety to



View of Large Machines at Bolton.

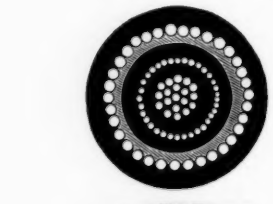


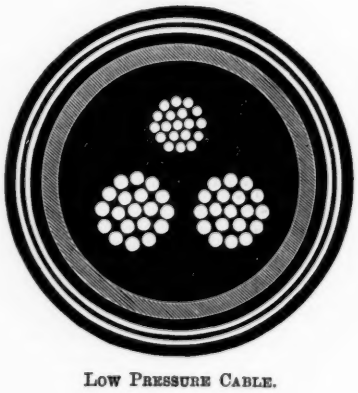
View of 50-Unit Alternator and one of the Exciters, Bolton.

patronise local enterprise, entrust their engines to firms with little or no experience of electric supply work. We are not finding fault with the engines which have been laid down at the Bolton works by Messrs. J. & E. Wood. They are, no doubt, excellent specimens in their way, but in some respects they are not altogether what one expects in central stations now-a-days. The principle of the design is excellent, but some of the details did not strike us as being altogether happy. They are of the compound vertical type, the fly-wheels being placed between the cylinders. The two large engines are of 160 H.P. each, with cylinders 13 inches and 21 inches diameter and 15 inches stroke, and run at 180 revolutions per minute. The smaller engine is for 80 H.P., having cylinders 10 inches and 15 inches diameter and 12 inches stroke, and runs at 220 revolutions per minute. The high pressure cylinders are fitted with slide valves, the cut-off valves being balanced and controlled direct from the governor, the variation in the cut-off being from nothing to the point of cut-off of the main valve. The low pressure cylinders are fitted with slide and cut-off valves, the cut-off being adjustable by hand. The framework of the engines, as will be seen from the drawings, encloses the working parts on both sides, the openings at the front and back being closed in by wrought-iron plates and doors. The governing arrangements are actuated by gearing wheel, and are adjustable while running. The exciters are combined with vertical engines of 15 H.P., made by Robey & Co.

The main dynamos consist of three "Mordey-Victoria" alternators, supplied by the Brush Company, and are of their

High Pressure Cable.





Low Pressure Cable.

well known type. Two of these machines are of the 100 kw. size, capable of giving 50 ampères at 2,000 volts, with a speed of 420 revolutions per minute, sufficient to light about 3,500 8-C.P. lamps, whilst the third one is just half the size, giving 25 ampères at 2,000 volts, with a speed of 600 revolutions per minute. All these machines are fitted with the latest improvements, including continuous lubricating arrangements, and are driven by cotton ropes, the larger ones by ten of 1¼-inch diameter, and the smaller one by eight of 1 inch diameter.

The alternators are mounted on strong slide rails, fitted with tightening screws and ratchet levers, so that the ropes may be readily tightened whilst running. The armatures are so arranged that any defective coil can be replaced in a few minutes, and the machines are guaranteed to work perfectly in parallel at any load.

The excitation of the alternators is effected by two "Brush-Falcon" two-pole dynamos, also supplied by the Brush Company; they are direct-driven, each being mounted on a combined bedplate with a "Robey" engine, and designed to run at 270 revolutions per minute.

Each exciter is capable of giving 90 ampères at 100 volts, or 70 ampères at 130 volts; in the latter case, for charging cells. This is considerably more than sufficient for the excitation of the whole of the alternators at present installed. These machines have drum armatures, and the fields are shunt-wound, being provided with large regulating resistances. They are fitted with the Brush Company's improved brush-holders, and with automatic lubrication in the form of chains running in baths of oil formed in the pedestals of the bearings. A similar exciter coupled with a "Brush-Falcon" engine is shown in one of our illustrations.

The Steam Raising Plant.

Three Lancashire boilers have been erected. In themselves they present nothing novel; they are 30 feet long × 7 feet 6 inches diameter. Each boiler has two internal flues, 3 feet diameter, with five Galloway tubes in each. The equipment of the boilers is their chief feature. They are each fitted with Meldrum's patent furnace. We have more than once referred to the special qualities of this apparatus, which render it one of the most valuable adjuncts to steam raising plant for central stations. It is not only valuable as a quick steam raiser, but its great utility is evidenced when using low class fuels. We shall take an early opportunity of referring to some good results that have been obtained when using these furnaces, results which we have actually witnessed. In the meantime we would say that it is the intention to use at Bolton coke breeze obtained from the gas works. We were until recently quite of the opinion that when using such low class fuels as coke breeze, no matter what system of forced draught was employed, it was necessary, when a demand for maximum power arrived, to leaven the coke breeze with coal, but judging from Meldrum's furnaces which we saw in Manchester and elsewhere, we shall be very much surprised if the heaviest loads at the Bolton station are not met with coke breeze. Sometime ago we gave illustrations of the general arrangement of the Meldrum furnace fitted to Lancashire boilers; we are now able to supplement those by a perspective view, which shows the superheater passing over the opening of the furnace. Further consideration, however, of this contrivance we will leave for the future.

The steam pipes are arranged on the ring system, and are made of wrought-iron. The exhaust pipes are carried over the feed water heaters into the chimney.

An interesting feature at the works is a set of accumulators, which is used for exciting purposes during hours of light load. They are charged from the omnibus bars by raising the pressure of the exciters.

The Switching Arrangements.

The switchboard, as will be seen from our illustrations, is placed in a gallery at the end of the generating room. Here the mains from the machines are brought, and are after synchronising, connected on to the feeders in the usual way. The board is provided with panels for the feeder circuits, alternators, exciters, and accumulators. Everything has been done to simplify the working of the switching arrangements, and the whole of the board could be controlled without much difficulty by a labourer.

The method of regulating pressure which has been devised by Mr. Rider is interesting. These regulators can raise the pressure 200 volts if required. They have primary coil and secondary coils, the primary being in shunt with the mains, and the secondary in series. The primary is a movable core, and when in the position of maximum induction through the secondary, each regulator gives 200 volts and 36 ampères in the secondary circuit. This position exists when the movable coil is in a vertical position. When, however, the core is in the position of minimum induction through the secondary, and with the primary fed at 2,000 volts, there is practically no induction through the secondary. These regulators are arranged in a room at the back of the switchboard, and the moving parts or coils are connected by means of gearing to the hand wheels placed on the front of the panels, as shown in the elevation.

The transformer chambers are equipped with eight "Mordey-Victoria" transformers of the 18 kw. size, manufactured by the Brush Company. They are arranged to run on the three-wire system, have earthed shields between the primary and secondary windings, and are fixed in cast-iron

cases, which also contain double pole high tension switches and fuses. The low tension wires are carried to special switch and fuseboards, also supplied by the Brush Company, whence they connect into the distribution network.

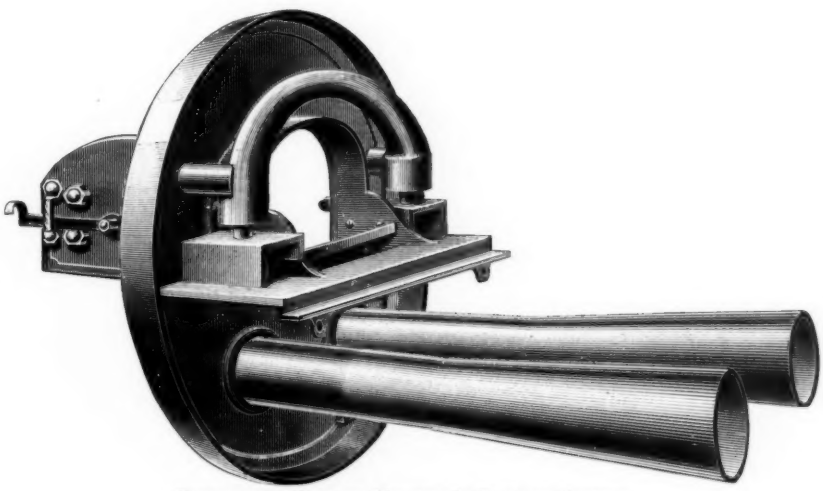
We give cross sections of the high pressure mains and the distributing mains. The high pressure feeders are concentric, insulated with vulcanised India-rubber, and armoured with galvanised steel wires. They run direct to the various transforming chambers, through cast-iron pipes. Spare pipes are laid in the main routes for extensions. The feeders are five in number, each having a cross-sectional area of ·0349 square inch.

The distributing cables, as will be seen from the cross-section, each consist of three separate conductors, insulated with jute fibre, twisted up together and then lead-covered and armoured. This arrangement of each strand for the purpose of overcoming inductive effects is such that, practically, a complete twist or turn is made about every 12 inches. These cables are of two sizes, having cross-sectional areas of ·125, ·0625, ·125 square inch, and ·0625, ·035, ·0625 square inch respectively. These cables are laid direct in the ground. Junction boxes are fixed at the points of intersection, so that any length may be readily isolated for testing or repairs.

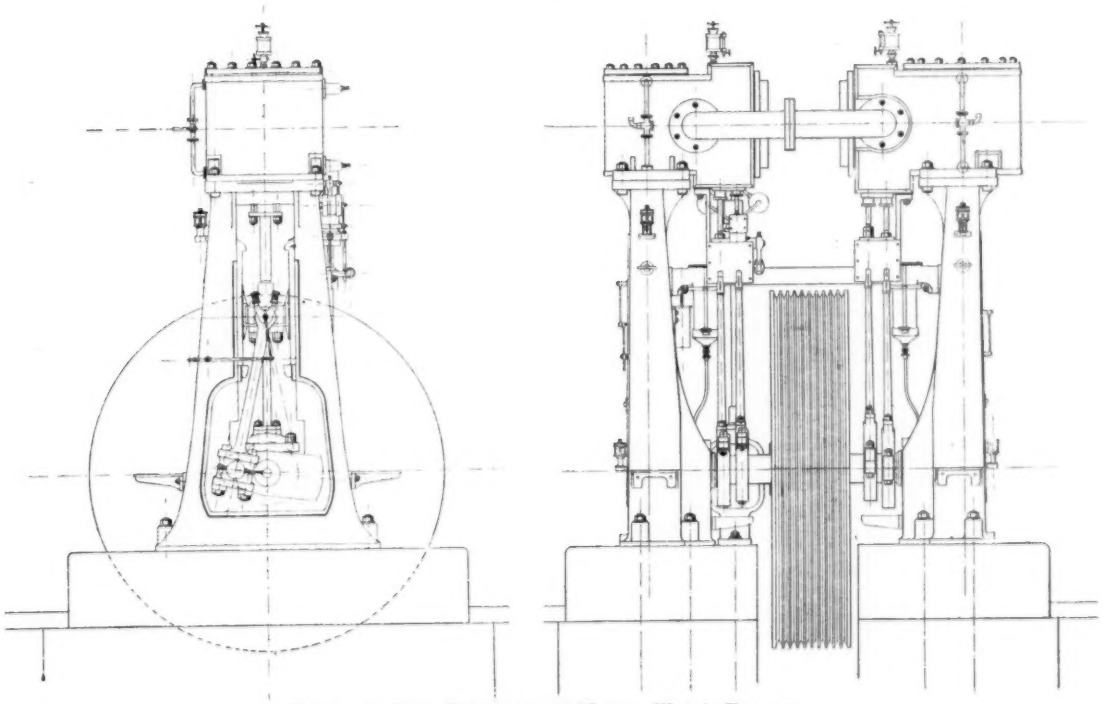
The service wires to the consumers are twin rubber cables, armoured, and laid direct in the ground. The joints are made in special cast-iron boxes, afterwards filled up with compound.

The Demand for Current.

The demand up to the present has been fairly extensive, and approximate to 3,500 8-C.P. lamps. It is proposed to make the following charges for current:—



Perspective View of Meldrum's Furnace Blower



Front and Side Elevations of Messrs. Wood's Engines.

			Per quarter.
Above	12½	B.T.U. per 16 C.P. lamp (or equivalent) fixed	5½d.
Between	10 and 12½	" " " " "	6d.
"	7½ " 10	" " " " "	6½d.
"	5 " 7½	" " " " "	7d.
"	2½ " 5	" " " " "	7½d.
Below	2½	" " " " "	8d.

The rental of meters will be as follows:—For 15 16-C.P. lamps or their equivalent, 2s. per quarter; for 40 16-C.P. lamps or their equivalent, 2s. 9d. per quarter; for 80 16-C.P.

lamps or their equivalent, 3s. 3d. per quarter; and for 160 16-C.P. lamps or their equivalent, 4s. per quarter.

A discount of 2½ per cent. will be allowed on all accounts paid within 21 days of the date thereof.

We understand that at present it is not contemplated to undertake street lighting, but we should think that it will be soon necessary to consider the matter.

Mr. Rider, the Borough Electrical Engineer, has carried out the whole of the work, and he is to be congratulated on the exceedingly creditable results.

NOTES.

(*Continued from page* 556.)

Cardiff.—Mr. Sydney F. Walker, writing to the *Western Mail*, complaining of the repeated delays at Cardiff, concludes his letter thus:—

> By the way, my old friends of the Electrical Review have come round to the view I have been advocating so long as to running dynamos in parallel. For years I have proclaimed, wherever I have had the opportunity, that it was wrong to run any dynamos in parallel, as the arrangement tended to bring severe and unnecessary strains upon each dynamo in succession, and considerably increased the liability to break down. The Electrical Review has now adopted the same view. There has been trouble with the City of London electric lighting plant, and my old friends now solemnly advise the City of London Company to give up running their dynamos in parallel.

We give an absolute denial to Mr. Walker's assertions. We did *not* recommend that the running of all alternators in parallel should be abandoned; if our "old friend" will refer to our remarks again, he will observe that we gave our advice regarding the "Mordey" apparatus, and not alternators in general. But for a man to deliberately pervert a statement, commend us to Mr. Walker.

Royal Society.—The following is a list of those who have been recommended by the President and Council of the Royal Society for election into the Council for the year 1895 at the anniversary meeting on November 30th:—President, the Lord Kelvin, D.C.L., LL.D.; treasurer, Sir John Evans, K.C.B., D.C.L., LL.D.; secretaries, Prof. Michael Foster, M.A., M.D.; the Lord Rayleigh, M.A., D.C.L.; foreign secretary, Sir Joseph Lister, F.R.C.S.; other members of the Council, Andrew Ainslie Common, LL.D.; William Crookes, F.C.S.; Francis Darwin, M.A.; Andrew Russell Forsyth, Sc.D.; Sir Douglas Galton, K.C.B.; Prof. Alexander Henry Green, M.A.; Sir John Kirk, K.C.B.; Prof. Horace Lamb, M.A.; Prof. Edwin Ray Lankester, M.A.; Prof. Alexander Macalister, M.D.; Prof. John Henry Poynting, D.Sc.; Prof. Arthur William Rücker, M.A.; Osbert Salvin, M.A.; Prof. J. S. Burdon Sanderson, M.D.; Thomas Edward Thorpe, Sc.D.; and William Henry White, C.B.

The Magnetarium.—The "Magnetarium" devised by Mr. Wilde, F.R.S., and exhibited before the Physical Society a short time ago, consists of a hollow geographical globe, wound all over the inner surface with insulated wire parallel to the equator. Within this globe is a sphere wound with wire on its surface, and having its axis inclined at 23½° to that of the outer pole. By means of epicyclic gearing the spheres can be made to rotate at slightly different rates. When electric currents of suitable strengths are passed through the two windings, the magnetic condition of the earth can be imitated both as regards distribution at any epoch and the secular variations. A better result is obtained by putting sheet iron over the land areas, and a still closer approximation by using thin iron over the water areas. Mr. Wilde has worked out a magnetic chart and tables giving the magnetic elements at various places for different epochs. Recent observations by the United States Survey at Ascension Island, and by Prof. Thorpe in Senegambia, have confirmed the results obtained by the magnetarium. Prof. Rücker says of it, that the "Siberian oval" is closely imitated; that the secular variations at Greenwich are well shown; but that in South America the approximation is not so good.

Darkness in Madrid.—On the evening of Wednesday October 30th, at half-past seven, all the districts (which would include about half Madrid) supplied with electric light by the Compania Madrilena, were plunged in darkness owing to the breaking down of one of the cables. Those theatres, including the Royal Opera House, served by the Compania Madrilena had, of course, to suspend their performances, and the general inconvenience was very great, as electric lighting in Madrid has, to a great extent, quite superseded gas, even in small shops and cafés. Lighting was provisionally re-established at half-past eleven, the company notifying that the usual service would be effected next day.

Aluminium Sulphide as a Source of Aluminium.—About two years ago it was demonstrated by A. H. Bucherer that aluminium sulphide is a convenient source of aluminium in preparing the metal in a pure state electrolytically. He pointed out that the sulphide possesses several advantages over the oxide, the chief of which is that considerably less energy is required for its decomposition than for that of the oxide. Moreover, the carbon anode is not attacked, short-circuiting is avoided, as the metal is of higher specific gravity than the bath, and the sulphur liberated can be recovered and utilised. Hitherto, however, we believe that aluminium sulphide has only been prepared upon a small scale from a heated mixture of carbon and alumina over which is passed sulphur vapour. This process is not adapted to the output of large quantities, and, besides, it demands that the alumina should be free from iron and silica. In the *Zeitschrift für Angewandte Chemie*, 1894 [10], p. 290, F. Gruy describes a new process for producing the sulphide advantageously. A bath is made of the double chloride of sodium and aluminium added to fused sodium sulphide, when aluminium sulphide and sodium chloride are formed. The fluoride of aluminium behaves in the same manner as the chloride. Amongst other substances clay may be used as a raw material, aluminium sulphate being formed when it is decomposed with sulphuric acid, and the sulphate being then fused with sodium fluoride. This reaction gives aluminium fluoride or cryolite, according to the proportion of sodium fluoride used; and from this, as before, aluminium sulphide may be obtained and reduced to the metallic state electrolytically.

Light Railways and Tramways.—A meeting of the Engineering, Electrical and Allied Trades Sections of the London Chamber of Commerce, and others interested in the construction of light railways and steam and electric tramways, was held last Friday at the offices of the chamber, Botolph House, Eastcheap, to consider a circular letter from the Railway Department of the Board of Trade, in reference to "a movement recently set on foot with the object of obtaining further powers and facilities for the construction of light railways and steam or electric tramroads," and "the requirements which are imposed by the Board of Trade upon new railways." Mr. R. E. Crompton, who presided, briefly opened the meeting, when a discussion followed, in which Messrs. Alexander T. Penney, F. Bolling, J. G. L. Stephenson, B. J. Jenkins Head, A. von Glehn, A. Macdonell, S. Sellon, Sydney Morse, E. Garcké, Major Flood Page, and Major-General Webber took part. The importance of light railways or tramways was generally recognised by the various speakers, and reference was made to the great success which had attended the working of such undertakings in Belgium, France and the United States. The want of success of the light railways constructed in Ireland was attributed to various causes. Major-General Webber said it would be quite a mistake to suppose that light railways in Ireland had not paid their way in any case. In two or three cases where there was sufficient traffic to serve they had paid, and the baronial guarantees had not been called for. On the motion of Major Flood Page, a resolution was unanimously passed expressing the opinion that the increase of light railways and steam and electric tramways would exercise a great and beneficial influence upon the internal trade of the country, and that the facilities for their construction throughout the kingdom should be increased. A further resolution was afterwards passed, on the motion of Mr. Garcké, appointing a committee to consider the whole subject of the Board of Trade circular on light railways, to determine the points and suggestions to be submitted to the Board of Trade, and to select, subject to the approval of the council, two delegates to represent the chamber at the proposed conference.

Institution of Civil Engineers.—The Civil Engineers will assemble in their old meeting room, on Tuesday next, to hear the address of the new President, as the new premises will not be ready for occupation till this time next year.

Failure of the Light at Worcester.—A local paper states that the electric light went out suddenly in all the public and private buildings and shops in the city on Friday evening last, causing inconvenience for the space of half an hour.

Fire.—A fire occurred in Corporation Street, Birmingham, on 1st inst., the local papers attributing the cause to the electric light fittings.

The building of the Edison Electric Light Company at Hackensack, New Jersey, was destroyed by fire on Tuesday morning. The loss is estimated at $30,000.

Breakdown at Chelmsford.—On Tuesday evening last week, the upper part of High Street was thrown into darkness by the extinction of the electric light. The contractors wrote, stating that the cause of this serious breakdown was the failure of one of the cables. They had taken immediate steps to remedy the defect, and to prevent any such occurrence in the future. The councillors are complaining of other lamps being out at other times.

The Northern Society of Electrical Engineers.—This society will meet at the Palatine Hotel, Hunt's Bank, Manchester, at 8 o'clock, on the following Monday evenings :—1894 : November 12th, December 10th (annual general meeting) ; 1895 : January 14th, February 11th, March 11th, April 8th, May 13th. The second annual dinner of the society will be held on Friday, January 11th, 1895.

Monday's (November 12th) paper on "Lighting Installations" will be read by H. A. Henderson, member.

Explosion at Glasgow.—Considerable excitement was created about half-past 11 p.m., on 1st inst., at the corner of Jamaica and Argyle Streets, owing to two electric light main box covers being thrown from their positions on the pavement. A young man was struck on the knee, but was not badly hurt. A young woman stepped into the hole left by the departed cover, and sprained her ankle. For about two minutes the light in Union Street, and for a short distance along Argyle Street, went out. The explosion was caused, says a Glasgow paper, by an accumulation of foul gas at the points where the electric conductors are jointed.

The Truth About the Hampstead Lighting.—There has been a good deal of comment in the Hampstead district on the alleged failures of the electric lighting. Now the facts are that the arc lighting machines did undoubtedly fail ; for that reason they have been rejected, and the contractors are now making new machines. Of course, the delay which has arisen is unfortunate, but beyond that the Vestry do not suffer any loss. It is interesting to give Mr. Preece's opinion on this matter, which was expressed at the meeting of the municipal engineers on Saturday last. Their only misfortune at Hampstead, he said, had been with the street lighting. On October 11th they lighted up for the first time, but they had not started the light yet in the streets. In about a fortnight's time their arrangements for street lighting would be complete, and then it would go with the same success as everything else. There was a rumour throughout the parish that the whole thing had broken down. A meeting of the Ratepayers' Association had been held, and the first resolution passed was that his commission should be stopped. He was perfectly certain of this, that the electric lighting industry in Hampstead is going to be financially a very great success, and he was quite satisfied that there would never be any demand upon the rates for any assistance at all. They had only been open three weeks, and had 2,176 lamps fixed, 1,218 in hand, and orders for 4,475 lamps, so that in less than a month they had got practically a load of 7,869 lamps. They only started with the idea of getting 10,000 lamps in two years. His impression was they would have 20,000 lamps in less than 12 months.

The Pacific Cable.—Messrs. Sandford Fleming and Mercer, the Commissioners, who have recently been in Honolulu endeavouring to secure Neckar Island as a landing place for the Pacific cable, have returned to Winnipeg. Mr. Fleming expresses the belief that his mission will prove successful.

Hull Institution of Engineers.—On Monday evening last the members of the above institution assembled at the Institute Rooms, Bond Street, Hull, to hear Mr. Alfred H. Gibbings read his promised paper on "Electricity on Board Ship, and its Application as a Motive Power for Auxiliary Machinery."

Cassel Gold Extracting Company, Limited, v. Cyanide Gold Recovery, &c., Company, Limited.—Judgment in this case was given yesterday. Mr. Justice Romer said he was confirmed in the opinion that this patent could not be sustained. The invention claimed in the patent was a very simple one, and the claim very comprehensive. It was for the application of a solution containing cyanogen, so as to dissolve the gold and silver in powdered ore. No special apparatus or machinery was required. At the date of the patent it was perfectly well known that a solution of cyanide of potassium would dissolve gold in a fine state of division if oxygen were present. Not only was the above mentioned property of cyanide of potassium known, but in 1867 one Rae took out a patent in the United States, which was published here before the date of the plaintiffs' patent. Again, in 1884, one Simpson took out a patent in the United States, which was published here before the date of the plaintiffs' patent. Simpson's process was identical with the plaintiffs', except that the solution he mentioned was one not of cyanide of potassium only, but a comparatively small quantity of carbonate of ammonia added. Under these circumstances, he came to the conclusion that at the date of the plaintiffs' specification, having regard to what was then published and known, there was no real invention in the plaintiffs' so-called discovery. If the patent were held valid, would not Rae's and Simpson's, if now used according to their specifications, be liable to be stopped as infringements ? Now, as the specifications of Rae and Simpson were published here before the date of the plaintiffs' patent, all persons in this country were at liberty to use the processes they set forth. For these reasons, the action must be dismissed, the general costs to be the defendants', and the costs of the issue of infringement the plaintiffs'.

BUSINESS NOTICES, &c.

Universal Electrical Directory (J. A. Berly's).—Messrs. H. Alabaster, Gatehouse & Co. have now in course of preparation the 1895 edition of this directory, which embraces all connected with the electrical trades throughout the Universe. It is indispensable to all having business transactions in the electrical world. Names and addresses for insertion, corrections, and orders for advertisements should be promptly forwarded.

Aberdeen.—The Town Council have now adopted the recommendation of the Gas and Electric Lighting Committee to double the present capacity of the electric lighting plant, as suggested by Prof. Kennedy. The total cost of the extension to plant and mains is estimated at £4,350. This, added to the amount already expended or contracted for, brings up the total capital cost of the electric lighting scheme to about £29,000. The distributing mains will be extended along both sides of Union Street, from their present termination at Bon Accord Street to Holburn Street, at an expense of £950, making a total outlay for the present extensions £5,300.

Belfast.—The electric lighting committee report that satisfactory progress has been made with the works for electric lighting since last meeting. The mains in the streets have been laid ; the central station building is approaching completion ; the batteries and three of the engines have been delivered, and the overhead crane has been placed in position and tested by the engineer. The committee have received applications for current for 2,360 8-C.P. lamps, which will about utilise the fourth of the generating power of the plant, and they anticipate a much greater demand.

Berlin.—A successful trial has just been made of the large electric lighting installation in the new Reichstag Buildings in Berlin. The installation, when finally completed, will comprise no less than 5,000 incandescent lamps and 62 arc lamps.

Blackburn.—The tradesmen of Darwen Street want the thoroughfare lighted better, and the Parks Committee recommended the erection of two arc lamps. The Gas Committee did not see their way to this, and referred the matter back to the Parks Committee.

Brighton.—The Lighting Committee the other day passed a resolution, stating that in their opinion the success which had attended the electric lighting undertaking of the Corporation is in a great measure to be attributed to the earnest advocacy and great administrative ability of Alderman Moon.

Bristol.—The new premises of Messrs. Jones & Co., in Wine Street, are lighted by electricity.

Burton.—Lord Burton has presented the town with some new Town Hall Buildings, comprising a council chamber, municipal offices and other premises. The council chamber his Lordship had lighted throughout by electricity at a cost of £1,000.

Bury.—Tenders have been received from five firms for the central electric lighting station and other works connected therewith, and these are being tabulated for comparison. Mr. G. E. Smirk has been appointed clerk of the works to superintend the erection of the buildings.

Cardiff.—Mr. W. H. Massey, consulting electrical engineer to the Cardiff Corporation, was interviewed by a local Press representative on Friday. Replying to a question as to the real position of affairs at the electrical works, he said:—

"The contractors have tested all their machinery at the station, including both the 300 horse-power sets, for which they had to provide an artificial load, and they inform me that everything is ready for the supply of current to private consumers whenever the corporation decide to commence operations. But with regard to the arc lighting they have had an accident with two of the transformers, the insulation of which may have been damaged by moisture, since they were delivered several months ago, and it will be some days yet before all the circuits can be worked in the streets. The whole of the lamps have been run for many hours at a time in the station by means of a rectified current sent back to the works from the rectifiers in the Town Hall cellars, and the result was very satisfactory. The transformers breaking down was a pure accident, which no one could foresee."

"Is a transformer a rectifier?"

"No, not in the sense I use the word. The rectifiers have worked perfectly all the time, and we have never had the slightest hitch. I am much pleased with them!"

"Mr. Sydney Walker says"—

"Oh yes; never mind what he says! He doesn't know as much as he thinks he does. His great water-power scheme, and his objection to everything which anybody on the face of the earth may propose as a distinct step in advance upon existing methods, will be forgotten; and while forgetting him, I hope we shall be charitable enough to forgive."

"Why has there been so much delay?"

"The delays have been numerous and most annoying. The contractors for the machinery worked night and day about a year ago to complete those portions of the apparatus which they were under penalty to deliver in December, 1893; but owing to strikes and other difficulties, the buildings were not ready in time. Then there were delays about the roof, so that we could not erect dynamos, &c., for fear of damage from wet; and behind all this was the knowledge on the part of everybody that the intending consumers were backward in coming forward."

Cork.—Within the last few months electric light has been installed for lighting both outside and inside several establishments. At "Donnybrook Fair," held a few days since, electric light was installed. The plant laid down for the occasion comprised one 12-horse-power portable steam engine; two 160 ampères, 100 to 110 volts, dynamos; one 45 ampères, 100 volts, ditto; one 15 ampères, volts ditto; six arc lamps, 1,000 incandescent ditto; 800 Ediswan bayonet-holders; while several miles of wires and cables of various sizes were used in connection therewith.

Dover.—The electric light company have notified the Council of their intention to extend their mains to Buckland Flour Mills.

Edinburgh.—Two electric lamps are to be fitted up in front of the Museum of Science and Art.

Heckmondwike.—Last week the electric light was used for the first time at the works of the gas company in the purifying department, the primary object being the avoiding of dangers to which the use of the ordinary gas light exposed the place. Messrs. A. Hirst & Sons, Dewsbury, have supplied the plant, which includes a dynamo capable of supplying 50 16-C.P. lights, 20 lamps being sufficient for the company's present purpose. The dynamo is driven by a 3 H.P. gas engine. The installation has cost £150.

Hobart.—Arrangements have been completed to apply to Parliament, next session, for an Act to authorise the lighting of Hobart streets and other public places with electricity. An engagement has been entered into with Messrs. Siemens Bros. to undertake the contract.

Houghton Hall.—The historical seat of the Walpole family, in Norfolk, and one of Inigo Jones's finest works, has recently been furnished with a complete installation of electric light for the present occupier, Viscount Grey de Wilton, by the Planet Electrical Engineering Company, of London. Over 500 lamps of 16 candle-power are used for the Hall, which has a frontage of some 400 feet, and the stables, which are about 100 yards distant, where, in addition, a powerful arc lamp is used to light the yard. An outstanding portion of the mansion formerly used as a brew house, has been altered to contain two complete sets of generating plant, consisting of two 16 H.P. oil engines, two shunt-wound dynamos with heavy fly-wheels, and two sets of accumulators of large capacity. Each set of plant is capable of independently supplying the greater portion of the lighting, so that in case of a stoppage of one set of plant for repairs, the second set will still continue in work, and the chances of a total failure are almost *nil*; the accumulators alone are of a sufficient size to keep the light going for a considerable period. The whole of the work, including the designing of special fittings and shades, and the adapting of the valuable chandeliers and other existing fittings, was carried out by the above company, under the supervision of their engineer, Mr. A. L. Shepard, and was successfully completed under contract within ten weeks from commencement.

Islington.—The Electric Lighting Committee recommended the vestry to accept the tender of Messrs. Moreland for the supply of ironwork required for the erection of the electric lighting station for the sum of £1,936, but the vestry referred the matter back, some of the members asserting that the tender had been "improperly accepted." The committee have power, if necessary, to advertise for fresh tenders.

Jamaica.—One of the shareholders in the Kingston Electric Light and Power Company, "feeling disgusted with the management of the company," after having allotted to him £100 worth of shares, upon which he paid part, desired to be freed from the concern by sacrificing the money already paid. The company, threatening an action, he paid down the remainder of his responsibility. It would seem from this that electric lighting affairs, even in Jamaica, are not in an altogether satisfactory condition.

Lancaster.—The Corporation propose to proceed with the extension of their area of supply, providing they meet with sufficient encouragement from the inhabitants of the district in question. "Notice has been given to the electric light contractors that if they should fail to proceed in an efficient manner with the works still required to be done, the Corporation will take possession of all plant, implements, and material on the works belonging to the company." Instructions consequent on this resolution have been given the borough engineer.

Larne.—The Commissioners consider that a wire supporting an arc lamp at the corner of Inver Road is decidedly dangerous, and the question of its removal has been referred to the county surveyor to settle with the electric light company.

London.—Mr. G. Stegmann, of Clapham Junction, has just completed an installation of "arc lamps" at a warehouse situated at 218, Upper Thames Street, E.C., consisting of four 2,000-C.P. lamps. There are also connections for heating and incandescent lighting, and the premises fitted are the basement, ground floor, and first floor.

Newport.—A local paper states that the light is likely to be turned on in January next. The demand from private consumers is said to be very large.

Portsmouth.—One hundred and twenty-seven gas lamp columns in the streets are to be removed, as they are not now required.

Reading.—The Highways and Lighting Committee report that a sub-committee conferred with Mr. McMullen, the electrical adviser of the Council, and submitted to him a section of the main which is being laid by the Reading Electric Supply Company, Limited, for the supply of electricity in the borough, and they inspected with him the manner in which the mains were being laid.

Richmond.—Messrs. Harrison Coles & Co. have been instructed to carry out the installation of Manor Farm, Horton, near Wraysbury, consisting of house, stables, cowsheds, dairy, packing warehouses, and other buildings, for Messrs. J. and R. Reffell. The engine will be a 4 H.P. Willans high speed type, complete with Newton dynamo and E.P.S. type accumulators.

Rochdale.—There was a general discussion at the Town Council's last meeting regarding electric lighting. An alderman recommended the electric lighting of the Town Hall and Technical School, &c. A councillor reminded the meeting that the large new boilers for the sanitary works were ordered partly with a view to generating power for electric lighting. The discussion is hoped to have the effect of waking up the sub-committee formed some time ago to consider the electric lighting question. A canvass of the tradesmen and others of the town will shortly be made for the purpose of ascertaining the probable consumption of current.

Swansea.—The Electric Lighting Committee, last week, received the report of the sub-committee which recently visited Liverpool, Oldham, Leeds, &c., to obtain information *re* electric lighting. Mr. Manville is to visit the town with a view to advising on the scheme.

Tuam.—The representative of a firm of electrical engineers visited Tuam last week, and had a conference with the leading merchants of the town with a view to starting the electric light there immediately.

Worcester.—The Council have received an application from Messrs. McKenzie & Holland asking that the current should be supplied to the Vulcan Works from 5 a.m. The Mayor stated that the committee were in a position to authorise the manager in charge to put on the current from 5 o'clock in the morning until 12 at night, and he proposed that this should be done. He had no doubt that in a fortnight they would be able to have a continuous current during

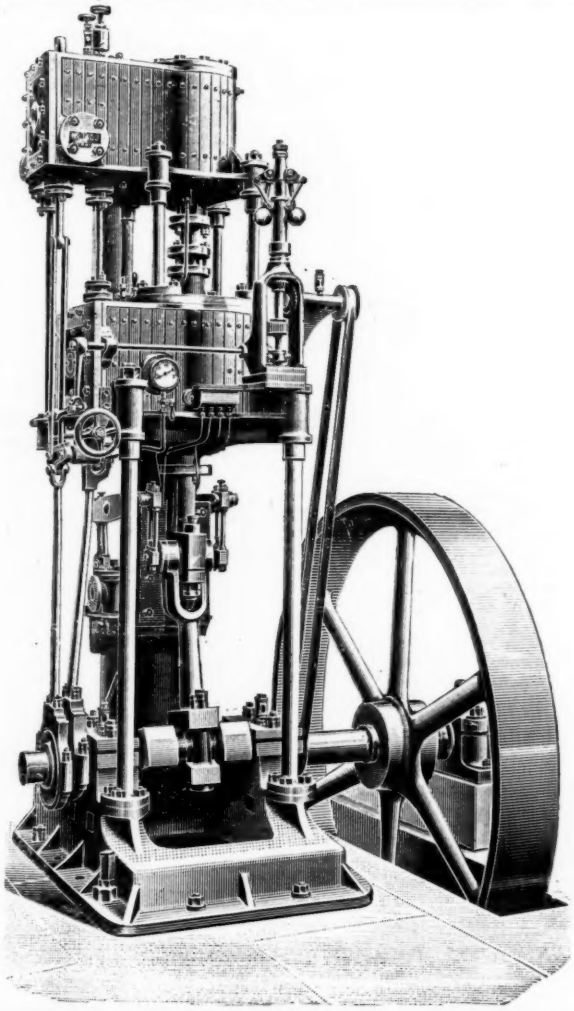
the 24 hours. Although they opened the generation station on October 11th, the entire work throughout the city was not completed, and the high tension main had to be interfered with for various purposes. They would also have the street lamps alight within the time he had mentioned. If they could have a continuous current for the 24 hours by the end of the first week in November, they would have achieved a great success. The lamps would probably be lighted again early next week.

Aberdeen Telephones.—The Chamber of Commerce are dissatisfied with the telephone service at Aberdeen, and have referred consideration of the matter to a committee.

Bankruptcy.—On Monday last the first meeting of creditors in Woilliard, Scarborough & Co., of Wade Street, Halifax, was held at the offices of the Halifax official receiver. The statement presented showed liabilities £530 17s. 11d., and assets £203 16s. 10d., leaving a deficiency of £327 1s. 1d. No resolutions were passed by the meeting, and the estate was left in the hands of the official receiver for realisation.

Change of Address.—The offices of the *Optician* and *Science Siftings*, are now removed from 78, Fleet Street to 125, Fleet Street.

Compound Vertical Tandem Engines for Electric Lighting.—In situations where considerable motive power is required, and the ground space available will not permit of side-by-side engines being used, the compound tandem arrangement has been found very advantageous. The illustration shows an engine of this



type constructed by Messrs. Alexander Shanks & Son for an electric light station on the continent. It is proportioned for working with steam up to 120 lbs. pressure per square inch, and constructed to run continuously at a high rate of speed. The governors are extremely sensitive, the bearing surfaces unusually large, and the provision for lubrication thoroughly complete. The engine is, of course, fitted with automatic variable expansion gear.

S. Dixon & Son.—The following is a list of some installations being carried out by the electric light department of Messrs. S. Dixon & Son, of Leeds:—For W. Bartram, Esq., Harrogate, new mansion, about 100 incandescents from 8 to 50-C.P. with complete steam plant and accumulators; for Rawson Kelleys, Esq., Harrogate, about 60 incandescent with gas plant and accumulators; Dewsbury Workhouse, between 800 and 900 incandescent with 2 25-H.P. steam engines and dynamos, also set of 23 K accumulators with all fittings; Yorkshire Penny Bank Chambers, with about 500 incandescent lamps with all electroliers, desk standards, and brackets, majority of which are in real bronze metal. The Bank premises were opened a short time since by the Duke and Duchess of Devonshire. Messrs. Roberts, Mart and Co., Bank Mills, East Street, Leeds, with 36 arc lamps, and about 150 incandescent on the three-wire system with two dynamos; for Messrs. Sands, Wilson & Co., Birstall, about 30 additional lights, 8-C.P. to 100-C.P.; also several shops and private houses in Leeds, wiring and fittings only. All the steam engines are by Messrs. Marshall, Sons and Co., Gainsbro'. The dynamos are by Messrs. Greenwood & Batley, and accumulators of the E.P.S. Company, Limited.

Erratum.—We regret that in our notice last week regarding the Berliner Electricitats Werke, a printer's error occurred. In line 6 the words "will be shortly cancelled" should read "will be shortly connected."

A. J. Harris & Co.—This firm of Bradford is now very busy supplying dynamos and other specialities to the trade. The following are some of the firms supplied with their dynamos:—J. P. Rushworth & Co., Bradford; Messrs. Trackson Bros., Brisbane, Australia; Messrs. Hewes & Geary, Burton and Leicester; and Messrs. Robinson, Norwich. Messrs. Harris have also several large orders in hand for motors and telephones, which have compelled them to work overtime.

Hedges's Patent Spring Reel Ceiling Roses and Wall Connections.—A few months ago, we gave a description of a portable standard fitted with an automatic self-winding arrangement for adjusting the length of the flexible cord invented by Mr. Killingworth Hedges, who has now applied this system to a complete series of electrical fittings for use where flexible wires require to be automatically adjusted in length or wound up out of sight when not in use. Our illustration shows a ceiling rose fitted on this principle,

and it is intended for use with adjustable pendants; this enables counterweights to be dispensed with, and has the advantage that it can be used with lamp fittings of various weights, the action of the spring reel being controlled by an extremely simple positive stop action, thereby preventing the lamp fitting from creeping downwards when it is left hanging, which it would otherwise tend to do. The height of the lamp may be adjusted as desired, by relieving the weight of same to raise it, whilst to disengage the stop action so as to lower the lamp it is necessary to raise it about an inch and then to lower it with more or less rapidity; but when released slowly the stop engages again. These reels will be found suitable for shop window lighting, and it is thought that they will come very largely into use instead of counterweights, which have their drawbacks. The wall connections are made on the same principle, and so designed that they may be let into the wall or floor flush with the surface; the spring reel being automatically controlled by the stop action described above, there is no strain on the flexible cord, which may be pulled out or wound up as desired. Each reel is fitted with connections for a safety fuse either of Hedges's patent mica-foil or of ordinary tin wire, and are manufactured by the Carboid Oil-less Bearing Company, Limited, who have recently removed from Carteret Street to 28, Victoria Street, Westminster, S.W.

Pocket Diary.—We have received a copy of the *Mechanical World* Pocket Diary and Year Book for 1895. As usual the book contains an enormous amount of valuable information and the price is only sixpence.

Provisional Orders.—The *London Gazette* contains announcements that the following authorities are applying for provisional orders during the 1895 session:—Carlisle Corporation; Walthamstow Local Board; New Swindon Local Board.

J. G. Statter & Co.—In the Chancery Division of the High Court, before Mr. Justice Vaughan Williams, the Bedford Engineering Company petitioned for an order to wind up J. G. Statter & Co., Limited. The winding up was resisted on the grounds that the creditors would suffer by a winding up. Counsel asked for the petition to stand over for a fortnight with the view of giving the company time to make arrangements with their creditors. The company expected to be able to dispose of its business and thereby acquire assets to satisfy the whole of the creditors. Mr. Justice Williams ordered the petition to stand over for a fortnight.

The German Accumulator Industry.—The report of the Hagen Accumulator Company for the financial year 1893-94, which has just been issued, shows a net profit of £31,456 as against £19,504 in the previous year. The dividend declared is at the rate of 10 per cent.

The Madras Electric Tramway.—The company carrying out this undertaking have obtained an equitable extension of time owing to a circumstance over which they had no control. The consideration of route, says *Indian Engineering*, in the city of magnificent distances is still occupying attention, and forms the subject of Municipal discussion.

Worcester Tramcars.—The Mayor has suggested that the Tramways Company should run their tramcars by electricity, and a sub-committee has been appointed to consider the matter.

CONTRACTS OPEN AND CLOSED.

OPEN.

Canary Islands.—Telephonic communication is to be established between Santa Cruz and Teneriffe, and tenders are at present being invited for carrying out the work.

St. Pancras.—Tenders are wanted by the Vestry for (*a*) supplying and laying armoured cable mains, (*b*) extension of underground sub-station building. Further particulars will be found among our advertisements.

CLOSED.

Aberdeen.—The following tenders were sent in for electric lighting Aberdeen Coffee Company's Buildings, Shiprow, Aberdeen:—

Northern Electric Supply Co., Cults, Aberdeenshire...	£94	0	0
Shirras, Laing & Co., Aberdeen...	94	11	0
New & Mayne, Aberdeen	110	0	0
Faraday Electrical Engineering Co., Limited, Glasgow	120	0	0

That of the Northern Company was accepted.

Birmingham.—The building sub-committee recommend the acceptance of the tender of the Walsall Electrical Company for the installation of the plant, fittings, and appliances, for both the lighting and provision of power in the new Technical School, for the sum of £6,375 18s.

St. Pancras.—The Electricity Committee of the vestry received the following tenders for switchboard, motor transformers, electrical instruments, &c., at King's Road Station:—

Muirhead & Co.	£5,639	12	11
Siemens Bros. & Co., Limited	4,994	8	2
Laing, Wharton & Down, Limited	4,889	1	7
Easton, Anderson & Goolden, Limited ...	4,399	10	0
Thames Iron and Shipbuilding Co., Limited...	4,185	13	6
Johnson & Phillips	3,843	18	3
Julius Sax & Co.	3,722	18	8
Acme and Immisch Electric Company, Limited	3,652	17	4
Crompton & Co., Limited	3,621	1	6
Lawrence, Scott & Co., Limited	3,603	5	0
Electric Construction Company, Limited ...	3,489	11	8
Edison & Swan Co., Limited (part of work only)	670	17	10

The tender of the Electric Construction Company, Limited, for £3,489 11s. 8d. has been accepted, subject to sureties, &c., proving satisfactory, but how can such differences in price exist for articles of daily use?

BOOKS RECEIVED.

Electric Lighting and Power Distribution. By W. Perren Maycock, M.I.E.E. Published by Whittaker & Co., London, E.C.

Electric Light Installations. Seventh edition, in 3 vols. Vol. 1, Accumulators; Vol. 2, Apparatus; Vol. 3, Application. By Sir David Salomons. Published by Whittaker & Co., London, E.C.

Electricians and their Marvels. By Thomas Jerrold. Published by S. W. Partridge & Co., Paternoster Row. Price 1s. 6d.

CITY NOTES.

The Petroleum Engine Company, Limited.

The annual general meeting of this company was held on Wednesday last. The attendance of shareholders was extremely small, there being apparently only three present besides the directors and secretary.

The notice convening the meeting having been read,

The Chairman addressed a few words to the meeting regarding the report published in our last issue, after which the retiring directors and the auditors were re-elected, and the meeting then terminated.

Judging by the report, and what could be gathered at the meeting, there can be but little doubt that not only has the reduction of royalties not brought the desired increase of business to Messrs. Priestman, but that the reverse is actually the case. Possibly the crux of the whole matter is that Messrs. Priestman's methods of manufacture are so expensive that they fail to hold their own in competition with other makers. If that is the case, were the royalties now remaining swept away altogether, the manufacturers might still be far out of the running. We commend this view of the matter to the consideration of the chairman and directors, who surely must see that it would be better in such circumstances to approach Messrs. Priestman Brothers, and to make an arrangement with that firm by which other licenses might be granted to those who can make similar engines with greater economy.

The West India and Panama Telegraph Company, Limited.

The directors' report for the half-year ended June 30th, 1894, to be submitted to the 35th ordinary general meeting, November 14th, 1894, states that the amount to credit of revenue is £40,593 1s. 2d. against £46,687 4s. 3d. for the corresponding half-year of 1893, and the expenses have been £24,488 17s. 5d. against £24,794 6s. 11d. for the same period in 1893, leaving a balance of £16,109 3s. 9d., which, with £718 12s. 8d. brought from last account, makes a total of £16,827 16s. 5d., with which it is proposed to deal as follows:—

First Preference Shares—			
Dividend, six months to June 30th, 6s. per share	£10,368	18	0
Second Preference Shares—			
Dividend, six months to June 30th, 6s. per share	1,400	14	0
Ordinary Shares—			
6d. per share (free of income tax)	2,208	0	6
Balance to current half-year's account ...	2,850	3	11
	£16,827	16	5

The traffic receipts for the six months show a decrease of £6,504 10s. 9d., as compared with the corresponding period, this decrease being due to the continued depression of West India trade, and to the fact that, in the corresponding half-year of 1893, this company's receipts were augmented by an interruption of the French Company's cable between Cuba and Haiti, which diverted traffic to this company's lines for a period of seven weeks. Since the close of the half-year, the directors regret to have to report a further falling off in the estimated traffic receipts up to date, and a somewhat heavy expenditure in repairs. They therefore deem it prudent to carry forward the sum of £2,850 3s. 11d. to the current half-year's account. The cost of repairs to cables during the half-year amounted to £11,373 19s. 11d. A large part of this expenditure is attributable to the difficulty experienced in repairing the duplicated cable between Jamaica and Cuba, which failed in about 2,000 fathoms. The great depth of water, combined with bad weather, prolonged repairing operations and caused the loss of a large quantity of grappling gear. The cable was at last hooked at a depth of 1,750 fathoms, and its repair effected with an expenditure of 25 knots of deep sea type. The directors are pleased to report that the Danish Colonies of St. Thomas and St. Croix have renewed their subsidies for five years.

TRAFFIC RECEIPTS.

The City and South London Railway Company. The receipts for the week ending November 4th, 1894, amounted to £939; week ending November 5th, 1893, £874; increase, £65; total receipts for half-year, 1894, £15,750; corresponding period, 1893, £14,680; increase, £1,070.

The Cuba Submarine Telegraph Company. The estimated traffic receipts for the month of October were £3,300; as compared with £3,058 in the corresponding month of last year.

The Direct Spanish Telegraph Company, Limited. The estimated receipts for the month of October, 1894, amounted to £2,101, against £2,121 in the corresponding period of last year.

The Great Northern Telegraph Company. The traffic receipts in October, 1894, were £27,200; January 1st to Octobr 31st, 1894, £234,600; corresponding months, 1893, £226,800; corresponding months, 1892, £223,600.

The Liverpool Overhead Railway Company. The traffic receipts for the week ending November 4th, 1894, amounted to £884; corresponding week last year, £608.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending November 2nd, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited were £2,861.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1891.	1892.	1893.	Closing Quotation October 31st.	Closing Quotation, November 7th.	Business done during week ended November 7th, 1894. Highest.	Lowest.
173,400*l*	African Direct Teleg., Ltd., 4 % Deb.	100	...	...	...	102 —105	102 —105	...	...
1,012,880*l*	Anglo-American Teleg., Ltd.	Stock	£2 12s.	£2 15s.	£2 11s.	35 — 37	36 — 38	37	...
2,993,560*l*	Do. do. 6 % Pref.	Stock	£5 5s	£5 10s.	£5 2s.	71 — 72	71½ — 72½	72	69
2,993,560*l*	Do. do. Defd.	Stock	...	...	...	6¼ — 6⅜	6¼ — 6⅜	6 9/16	6⅜
130,000	Brazilian Submarine Teleg., Ltd.	10	8 % §	6½ % §	6½ % §	12½ — 13	12½ — 13	13	12⅝
75,000*l*	Do. do. 5 %, repayable June 1906	100	...	...	...	110 —114	110 —114	...	...
44,000	Chili Telep., Ltd., Nos. 1 to 40,000	5	... §	10%‖ §	... §	2 — 3	2 — 3	...	...
10,000,000$	Commercial Cable Co.	$100	7 %	7 %	7 %	135 —145	135 —145	...	...
224,850	Consolidated Telep. Const. and Main., Ltd.	10/-	3½ % §	2 % §	2 % §	¼ — ½	¼ — ½	...	...
16,000	Cuba Teleg., Ltd.	10	8 %	8 %	8 %	12½ — 13½	12½ — 13½	...	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	19 — 20	19 — 20	...	...
12,931	Direct Spanish Teleg., Ltd., £4 paid	5	4½ %	4 %	4 %	4¼ — 4⅜	4¼ — 4⅜	...	...
6,000	Do. do. 10 % Pref.	5	10 %	10 %	10 %	9¼ — 9⅜	9¼ — 9⅜	...	...
30,000*l*	Do. do. 4½ % Debs of £50, Nos. 1 to 1,600	...	...	...	...	105 —108%	105 —108%	...	...
60,710	Direct United States Cable, Ltd., 1877	20	3½ % §	3½ % §	2⅝ % §	8 — 8½	8 — 8½	8 3/16	...
400,000	Eastern Teleg., Ltd., Nos. 1 to 400,000	10	6½ % §	6½ % §	6½ % §	15⅜ — 16	15⅝ — 15⅞	15⅞	15½
70,000	Do. 6 % Pref.	10	6 % §	6 % §	6 % §	16½ — 17	16½ — 17	17	16⅝
102,100*l*	Do. 5 % Debs., repay. August, 1899	100	...	...	...	106 —110	106 —110	...	...
1,297,837*l*	Do. 4 % Mort. Deb.	Stock	...	...	...	118 —121	119 —122	120⅜	119
250,000	Eastern Extension, Australasia and China Teleg., Ltd. ...	10	7 %	7 %	7 %	15⅞ — 16⅛	15¾ — 16	16	15¾
54,100*l*	Do. 5 % (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326	100	...	...	...	103 —106	103 —106	...	...
194,300*l*	Do. do. Bearer, 1,050—3,975 and 4,327—6,400	100	...	...	...	103 —106	103 —106	...	...
320,000*l*	Do. 4 % Deb. Stock	Stock	...	...	...	116 —120	116 —120	118	...
95,100*l*	Eastern and South African Teleg., Ltd., 5 % Mort. Deb. 1900 redeem. ann. drgs., Reg. Nos. 1 to 2,343	100	...	...	...	103 —106	103 —106	...	...
129,100*l*	Do. do. do. to bearer, 2,344 to 5,500	...	...	...	...	103 —106	103 —106	...	...
300,000*l*	Do. 4 % Mort. Debs. Nos. 1 to 2,016, red. 1909	100	...	...	...	104 —107	104 —107	...	...
200,000*l*	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1 to 8,000	25	...	...	...	109 —112%	107—110% xd	...	...
180,227	Globe Telegraph and Trust, Ltd.	10	5½ % §	4½ % §	4⅝ % §	8⅝ — 8⅞	8⅝ — 8⅞	8⅞	8⅝
180,042	Do. do. 6 % Pref.	10	6 % §	6 % §	6 % §	15½ — 16	15½ — 16	16	15½
150,000	Great Northern Teleg. Company of Copenhagen	10	8⅗ % §	8⅗ % §	8⅗ %	20½ — 21½	20½ — 21½	21⅛	20¾
190,000*l*	Do. do. do. 5 % Debs.	100	...	...	...	105 —108	105 —108	...	...
17,000	Indo-European Teleg., Ltd.	25	10 %	10 %	10 %	46 — 48 xd	46 — 48 xd	46¾	46½
37,548	London Platino-Brazilian Teleg., Ltd.	10	...	...	...	5 — 7	5 — 7	...	...
100,000*l*	Do. do. 6 % Debs.	100	...	...	...	107 —110	107 —110	...	...
15,000	Monte Video Teleph. Co., Ord., 1 to 15,000	5	...	...	...	¼ — ⅜	¼ — ⅜	...	...
28,000	Do. do. 6 % Pref., 1 to 28,000	5	...	...	...	1 — 2	1 — 2	...	...
484,597	National Teleph., Ltd., 1 to 438,984	5	6 % §	5 % §	5 % §	4⅞ — 5⅛	4⅞ — 5⅛	5⅛	4 15/16
15,000	Do. 6 % Cum. 1st Pref.	10	...	...	...	15 — 16	15 — 16	16	15 9/16
15,000	Do. 6 % Cum. 2nd Pref.	10	...	...	...	14 — 15	14½ — 15½	15½	...
119,234	Do. 5 % Non-cum. 3rd Pref., 1 to 90,950	5	...	...	...	5½ — 5¾	5½ — 5¾	5 11/16	...
1,000,000*l*	Do. 4½ % Deb. Stock Prov. Certs. ...	...	...	...	...	110 —113	110 —113	...	...
48,800	New Teleph., Ltd., 25,901 to 74,700; £4 paid	10	...	...	...	... ...	... ...	...	...
171,504	Oriental Teleph. & Elec., Ltd., Nos. 1 to 171,504, fully paid	1	...	...	...	1/16 — 1/8	1/16 — 1/16	...	...
100,000*l*	Pacific and European Tel., Ltd., 4 % Guar. Debs, 1 to 1,000	100	...	...	...	104 —107	104 —107	...	...
11,839	Reuter's Ltd.	8	5 %	5 %	0 %	3 — 5	3 — 5	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	104 —109	103 —108	103½	...
58,000	United River Plate Teleph., Ltd.	5	...	...	...	2 — 3	2 — 3	...	...
146,733*l*	Do. do. 5 % Debs.	Stock	...	...	...	88 — 94	88 — 94	...	...
15,609	West African Teleg., Ltd., 7,501 to 23,109	10	4 %	..	0 %	3 — 5	3 — 5	...	...
249,900*l*	Do. do. do. 5 % Debs.	100	...	...	...	100 —103	100 —103	101½	...
30,000	West Coast of America Teleg., Ltd.	10	...	...	...	1½ — 2½	1½ — 2½	...	...
150,000*l*	Do. do. do. 8 % Debs., repay. 1902	100	...	...	...	101 —106	101 —106	...	...
64,242	Western and Brazilian Teleg., Ltd.	15	4 %	2½ %	2½ %	9 — 9⅛	9¼ — 9⅜	9½	9⅛
33,129	Do. do. do. 5 % Cum. Pref. ...	7½	...	...	...	6½ — 7	6½ — 7	...	...
33,129	Do. do. do. 5 % Def.	7½	3 %	...	...	3 — 3½	3¼ — 3⅜	3 1/16	3 1/16
171,900*l*	Do. do. do. 6 % Debs. "A," 1910 ...	100	...	...	...	106 —109	107 —110	...	...
214,800*l*	Do. 6 % Mort. Debs., series "B," red. Feb. 1910	100	...	...	...	106 —109	107 —110	...	...
88,321	West India and Panama Teleg., Ltd.	10	¼%	¼%	⅜%	1½ — 1⅝	1⅝ — 1⅜	1 1/16	1⅛
34,563	Do. do. do. 6 % 1st Pref. ...	10	...	...	...	11 — 11½	11 — 11½	11⅛	...
4,669	Do. do. do. 6 % 2nd Pref. ...	10	...	...	...	9 — 10	9 — 10	...	...
80,000*l*	Do. do. 5 % Debs. (1917) No. 1 to 1,000	100	...	...	...	108 —111	108 —111	...	...
$1,211,000	Western Union of U. S. Teleg., 7 % 1st Mort. Bonds ...	$1000	...	...	...	115 —120	112 —118 xd	...	...
166,900*l*	Do. do. 6 % Ster. Bonds.	100	...	...	...	102 —104	102 —104	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electy. Supply, 1 to 6, 215 to 718, and 10,001 to 30,000	5	...	5 %	4½%	4½ — 5½	4½ — 5½	...	...
40,000	City of London Elec. Lightg. Co., Ltd., Ord. 40,001—80,000	10	...	...	...	13 — 14	12½ — 13½	13¼	12 11/16
40,000	Do. do. 6 % Cum. Pref., 1 to 40,000	10	...	6 %	6 %	14⅜ — 15¼	14⅜ — 15¼	15	14¼
100,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	...	...	...	131 —133	131 —133	132½	...
50,000	†Liverpool Electric Supply, all paid	5	4½%	5 %	5 %	6⅝ — 6⅞	6 9/16 — 6 11/16	6⅝	...
49,900	*Metropolitan Electric Supply, Ltd., 6,101 to 50,000 ...	10	1 %	2 %	2½ %	9¼ — 9⅜	9¼ — 9⅜	9¼	9½
100,000*l*	Do. 5% Deb., 1 to 10,000 in bonds of £10, £20, £40	...	...	...	...	... — ...	... — ...	114	...
6,452	Notting Hill Electric Lightg. Co., Ltd.	10	...	...	...	5½ — 6½	6 — 7	...	...
19,980	St. James's & Pall Mall Elec. Light Co., Ltd., Ord., 101-18,780	5	8½%	7¼%	4½%	7⅜ — 8¼	7⅜ — 8¼	...	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	8⅜ — 9¼	8⅜ — 9¼	...	...
59,900	*Westminster Electric Supply Corp., Ord., 101 to 60,000 ...	5	...	3½%	4 %	6¾ — 7¼	7 — 7½	7¼	7 1/16

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid. ‖ Dividends paid in deferred share warrants, profits being used as capital.

Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL, COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1891.	1892.	1893.	Closing Quotation, Oct. 31st.	Closing Quotation, Nov. 7th.	Business done during week ended Nov. 7th, 1894. Highest.	Lowest
90,000	Brush Elecl. Enging. Co., Ord., 1 to 90,000...	3	...	6 %§	6 %§	2⅜— 2⅝	2⅜— 2⅝	2½	2 7/16
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	...	6 %§	6 %§	2¼— 2⅜	2⅜— 2⅝	2½	...
125,000/	Do. do. 4½ % Deb.	Stock	...	...	...	111 —114	111 —114	...	...
630,000/	City and South London Railway	Stock	...	⅝%	⅝%	36 — 38	37 — 39	38	...
28,180	Crompton & Co., Ltd., 7 % Cum. Pref. Shares, 1 to 28,180	5	7 %§	7 %§	7 %§	2 — 2½	2¼— 2¾	...	...
50,000/	Do. do. 5 % 1st Mort. Debs., 1—400 of £100, and "A" 1—200 of £50 each	...	...	...	...	94 — 99	95 —100	...	...
120,000	Electric Construction, Ltd., 1 to 120,000	2	...	...	...	⅜— ⅝	⅜— ⅝	...	...
12,845	Do. do. 7 % Cum. Pref., 1 to 12,845 ...	2	...	...	...	1½— 2	1½— 2	...	...
100,000	Elmore's French Patent Cop. Deposg., Ltd., 1 to 66,750 ...	2	*nil*	*nil*	*nil*	9/16— 5/8	½— ¼	...	...
91,195	Elmore's Patent Cop. Deposg., Ltd., 1 to 70,000	2	*nil* ¶	*nil*	*nil*	1⅜— 1⅝	1⅜— 1⅝	...	...
67,385	Elmore's Wire Mfg., Ltd., 1 to 67,385, issued at 1 pm. ...	2	*nil*	*nil*	*nil*	1⅛— 1⅜	1⅛— 1⅜	...	...
20,000	Fowler-Waring Cables, Nos. 301 to 20,300	5	*nil* §	*nil* §	*nil* §	½— 1½	½— 1½	...	...
9,600/	Greenwood & Batley, Ltd., 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	...	...	6½— 7½	6½— 7½	...	...
6,837	Henley's (W. T.) Telegraph Works, Ltd., Ord.	10	5 %	5 %	5 %	8 — 9	8 — 9	...	...
50,000	India-Rubber, Gutta Percha and Teleg. Works, Ltd. ...	10	12½%	12½%	12½%	24½— 25½	25 — 26	25 11/16	25¼
200,000	Do. do. do. 4½ % Deb., 1896	100	...	...	...	102 —104	102 —104	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	...	...	1 %	8 — 8½	8 — 8½	8⅝	...
6,295	† Do. do. Pref., £8 paid	10	...	...	...	13 — 13½	13 — 13½	...	...
	Swan United Electric Light, Ltd.	...	11 %§	10 %§	7½%§	... — ...	... — ...	...	...
37,350	Telegraph Constn. and Maintce., Ltd.	12	20 %	15 %	20 %	41 — 43	41 — 43	41¾	41½
150,000/	Do. do. do. 5 % Bonds, red. 1894	100	...	...	...	106 —109	106 —109	...	...
54,000	Waterloo and City Railway, Nos. 1 to 54,000, £2 paid ...	10	...	...	...	2 — 2¼	2⅛— 2⅜	2¼	2⅛

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ Last dividend paid was 50% for 1890.

Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

Crompton & Co.—The dividends paid on the ordinary shares (which have not a Stock Exchange quotation), are as follows: 1892—0%§; 1891—7%§; 1890—8%§.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

Birmingham Electric Supply Company, Ordinary of £5 (fully paid), 5⅜—6.
Electric Construction Corporation, 6 % Debentures, 87—92.
Electric and General Investment, shares of £5 (£1 paid), 1¾—2¼.
House-to-House Company (£5 paid), 2¼—2½.
Do. do. 7 % Preference, of £5, 6½—6⅝.
Do. do. 6 % Debentures of £100, 101—103.
Kensington and Knightsbridge Electric Lighting Company, Limited, Ordinary Shares £5 (fully paid) 4¾—5¼; 1st Preference Cumulative 6 %, £5 (fully paid), 6½—6⅝.
Liverpool Electric Supply, £5 (fully paid), 6⅜—6½.
London Electric Supply Corporation, £5 Ordinary, ⅞—1⅛.
Queen Anne's Mansions Lighting and Heating Company, 6 % £100 Debentures, 101—103.
Yorkshire House-to-House Electricity Company, £5 Ordinary Shares (£4 10s. paid), 4¼—4⅜.

Bank rate of discount, 2 per cent. (February 22nd, 1894).

LEGAL.

Muirhead *v.* Commercial Cable Company.

This action, which was heard by Mr. Justice Kennedy, without a jury, throughout seven days in March last, when he reserved judgment, and in April found for the plaintiffs for £3,566 and interest, on Friday last, and subsequent days, came before the Master of the Rolls and Lords Justices Lopes and Rigby, on appeal from that judgment by the defendants.

The claim was based on royalties due under an agreement giving the defendant company the right to use certain patents in duplex telegraphy belonging to the plaintiffs for the transmission of messages simultaneously over the same conductor. The defendant company paid into Court £135 13s. 5d. for royalties to July, 1891, and, denying further liability, the case came on for trial. In the result, his Lordship came to the conclusion that a duplex combination, patented in the United States in 1880, was a new invention, and not, as was contended, the invention for which an English patent had been granted in 1876, and that consequently, tested by the principles enunciated in cited American cases, the allegation of the identity of the patents upon which the defence was based had failed. The patent of 1880 being, at the date when the payments claimed fell due, a lasting patent, he gave judgment for the full amount claimed, with costs. Hence the present appeal, in which Sir Richard Webster, Q.C., Mr. Fletcher Moulton, Q.C., and Mr. A. J. Walter were counsel for the defendant cable company, as appellants; Mr. Finlay, Q.C., Mr. Bousfield, Q.C., and Mr. E. W. Pollard were for the respondents.

In a speech extending over several hours, Sir Richard Webster, having indicated the nature of the appeal, said the defendants held a license to use many of the inventions contained in several specifications, notably one granted in England in 1876 and an American specification granted in 1880. There were earlier specifications involved, of 1874, 1875, and 1876, and also some Canadian specifications; but the only ones he need bring before the Court were the American specification of 1880 and the English specification of 1876. The material point for the consideration of the Court was whether or no the inventions patented in America became the same as were patented in 1876. The license was granted for the whole period during which the patent should last. The learned judge below found that the license came to an end if it contained the same invention as the English. In one case the defendants' payment would cease; in the other it would continue, and defendants said it was the same. Under their agreement defendants were to pay an annual royalty of £1,250 for each cable, and if the American patent had come to an end and ceased, then the royalty ceased. The appellants' contention was that by the operation of law the American patent had come to an end, and for this reason: It was found as a fact by the learned judge that if the American specification contained the same as the English, it came to an end when the English patent came to an end. This English patent of 1876 was dated June 21st, and therefore came to an end on June 21st, 1890, 14 years after 1876; and what was sued for was a number of half-years' royalties subsequent to the last-mentioned date. There were also letters patent of 1877 which came to an end in 1891.

The Master of the Rolls: What is said against you?

Sir R. Webster said his Lordship held that the American patent was not ended, because he was not satisfied that it included the same invention as the English.

Lord Justice Lopes: Isn't that a question of fact?

Sir Richard Webster said certainly it was; but the question of fact depended almost entirely upon the construction of the two specifications.

The Master of the Rolls: If so, it was for the judge to construe.

Sir R. Webster assented, and said the judge had found in appellants' favour. It was contended by the plaintiffs that steps had to be taken to put an end to the American patent, and if not it remained alive, and defendants must pay. There being an agreement between the parties that questions of American law were to be decided by the English judge, his Lordship found, on the American authorities, that it did not require any steps to be taken to put an end to the American patent, and that if he had been satisfied that the American specification contained the same invention as the English, the American would have died and ceased when the English came to an end. Consequently he found in favour of the plaintiffs. In answer to Mr. Finlay on the trial, who submitted that a licensee could not raise the question, Mr. Justice Kennedy also held that by the English and American law a licensee could raise that question.

Replying to a question by the Master of the Rolls, Sir R. Webster said that it was the law of many countries, America among them, that a patent only lasted the life granted to it in the first country where the invention took place. The first country where this particular patent was taken out was England, in 1876. The question was, was there a sufficient identity between the two to bring in the American law on the subject—in other words, were the lives of the patents concurrent?

The Master of the Rolls: That is, it is said, the American patent ceased because the English had run out.

Sir R. Webster assented, and added that there were also several Canadian patents, and it was admitted below, or, to be strictly correct, Mr. Finlay said he did not dispute that the Canadian law agreed with the laws of America and other countries in its bearing upon patents granted by them on English patents. Unless the view appellants contended for was correct, the undoubtedly great invention of Mr. Muirhead would be unprotected in America. He went on to say that he proposed to give their Lordships, in language as

little shorn of technicalities as possible, such information as was necessary to the understanding of the specification, respecting what, after all, was a most interesting subject.

The Master of the Rolls: It may be interesting to you, and I don't complain; but you may proceed on the assumption that it doesn't interest me at all, except as a matter of duty; and I don't care a whit about it.

Sir R. Webster: I will only say that Mr. Justice Kennedy described Mr. Finlay's opening of the case one of the most interesting he ever heard.

The Master of the Rolls: Then I feel myself corrected for my observation.

In describing the principle of duplex telegraphy, which was at the bottom of this claim, Sir R. Webster proceeded to say he must use a few words which it might be difficult to understand. A rheostat would have frequently to be mentioned.

The Master of the Rolls: A what did you say?

Sir R. Webster: A r-h-e-o-s-t-a-t, which is the professional way of describing what, in common parlance, is nothing more than a resistance box. Before the invention, he explained, with considerable detail, the transmission of a message through a submarine cable involved continual interruptions, an outward dispatch coming back through the receiving instrument.

The Master of the Rolls: What came back?

Sir R. Webster: That is just what it has taken a generation of investigators to find out, and they have not yet succeeded. I don't know, and I don't think anybody else knows. We have by the aid of the earth a complete circle, and perhaps a wave or undulation best describes it in untechnical language. Under the old plan the despatch of a word to America would not only be read upon the receiving instrument there, but it would disturb, and perhaps might produce the same indications upon the receiver at the English end. The discovery of duplex telegraphy had rendered the receiving instrument at either end neutral, or at rest as regarded the other end. Describing the invention by the aid of a diagram and a neatly prepared metal model, for which Sir R. Webster said they were indebted to the mechanical skill of his junior, Mr. Walter, Sir Richard Webster pointed out how there was built up an artificial reservoir or cable, then the undulations were split, and, by the aid of Sir W. Thomson's syphon recorder, two circuits were made, where before there was but one; and so the passage of the message did not affect the receiving instrument. Next, similarly describing the condensers, as part of the scheme, he said that the appellants' case was that the real and only invention in the 1876 and American patents was the putting of these condensers into the bridge arms. Plaintiffs' contention was that this was not so, but that the invention was putting the resistance box or rheostat at that (pointing it out) particular point of the apex of the bridge. It would be for the Court to say which of these views was the correct one. That the rheostat was old and perfectly well known was not in dispute, and it must have been in use long before 1876, when the specification was taken out. They should submit that putting it in the place suggested by the other side was not in accordance with the specification.

The Master of the Rolls: Would it act if in any other place?

Sir R. Webster said it was their case that it would; that no part of the merit of the invention depended on the particular place in which it was put, and, even if it did, that was not the invention meant to be patented in America. Having given the details of the English specification, which in the provisional was "for an improvement in the method of working duplex telegraphy, especially in submarine cables," to which, in the complete specification, it was added, "in conjunction with compensating circuits," the learned counsel pointed out what the cable company considered the essence of the invention. It was not disputed that great benefits resulted from the reduction of resistance and retardation by putting the condenser in the bridge arms; and it was common ground that the invention could not be worked without adjusting the resistance put somewhere in the bridge; it was also common ground that you could not make an effective instrument without having the means of adjusting the resistance somewhere between what had been pointed out as the apex of the bridge and M and N in fig. 2 of the diagram. Plaintiffs must, of course, make a working invention, and it was common knowledge at the time that to make fig. 2 work, a resistance block must be put in, but there was no suggestion in the specification how or where. Mr. Justice Kennedy was extremely impressed with this in the course of the case, and he (the learned counsel) believed its effect had not disappeared when his Lordship gave his judgment, although he came to a different conclusion.

Mr. Finlay intimated that he did not on the trial agree as to common knowledge; the evidence was that it had not been known till years afterwards.

Sir R. Webster said in the end Mr. Justice Kennedy agreed that neither figs. 1 nor 2 could be worked without the resistance box; the whole point was whether putting it on the apex was enough to differentiate the American specification from the English. Between 1876 and 1880 the patentees did not put their scheme to work, and they did not try the bridge condenser until just before the American patent; but shortly before the Americans found out that these bridge condensers were the best way, and so in 1880 the American patent was obtained. This brought him to the American specification, which he passed in review, and submitted that whilst the evidence showed the resistance box at the apex had no bearing on the object aimed at, there were other indications that they picked out for the purpose of getting their American patent the particular thing in the English specification which appeared to be the means of arriving at the best results.

In answer to Lord Justice Lopes, Sir R. Webster said there was no difference in figure 2 between the American and English specifications, the only distinction was an alternative position for the receiving instrument; and fig. 1 was the same in both, except the rheostat.

In answer to Lord Justice Rigby, the Learned Counsel further said that the condensers were not new. The placing them in such a position with reference to the rest of the apparatus that they would have certain effects was the point; it was not the question of the object only, but also of the means. Reviewing the evidence, which Sir Richard prefaced by the remark that he admitted what had been achieved was not only a new thing, but was a really great invention, he went on to say that the witnesses included several great names, which could not be mentioned but with respect—Lord Kelvin, Prof. Silvanus Thompson, and others, but it was a fact that, with but one exception, these great men had had no practical experience of the work of duplex telegraphy, and the only one called having this practical experience (Mr. Taylor) admitted the view he (Sir Richard) was presenting to their lordships.

At this point the hour of adjournment was reached, and the Court said it would sit on the morrow and, if necessary, also hear Sir R. Webster on Monday, in order that the case might be cleared off the list.

Second Day.

Sir R. Webster, continuing his arguments this morning, said when the Court adjourned yesterday he was endeavouring to satisfy their Lordships, upon the defendants' evidence, that the position of the rheostat had no effect upon the invention. He now proposed to deal with the witnesses whose evidence appeared to impress Mr. Justice Kennedy with a contrary view; and he should ask their Lordships to come to the conclusion that, upon the evidence of the plaintiffs, it was not contended that putting of the rheostat in a particular place produced the beneficial results described in the new combination. In other words, he should submit that their evidence corroborated the patentee's own statement. It was attempted to be said that the American invention consisted in taking resistance out of the bridge arms altogether; but if their Lordships would turn to fig. 2 of the American patent, they would find the resistance still left in the bridge arms—that was, it was part of the American combination to have the resistance in the bridge arms. Whilst fig. 2 described the invention, it was not till they came to fig. 3 that there was an attempt to take resistance out of the bridge arms, and to claim fig. 2 as well as fig. 3. They would find, by the admission of plaintiffs' own witnesses, that it was not taking resistance out of the bridge arms which produced the benefit, but the putting the condensers into the bridge arms. He proceeded to quote the evidence on this point which appeared to have impressed the learned judge in the Court below, and led him to a contrary view to that which he hoped to secure from their Lordships. It could not be asserted that fig. 2 was not claimed in the American specification, and in that figure there was resistance in the bridge arms; and he should contend that the American patent should be construed as though the putting of the condensers led to no resistance as distinguished from the condensers in the bridge arms which had resistance. He claimed that nothing could put his point more completely than the evidence which he read that fig. 1 had everything in it to support his view that the invention was a combination well known in duplex machinery of putting the condenser in the bridge arms.

The Master of the Rolls: What for?

Sir R. Webster said to reduce the retardation of the signals, and, by getting a balance, to increase the speed of transmission; and he submitted that it was not extravagant to argue as he did, seeing that there was nothing to indicate the rheostat as having a special value, but treating it as common knowledge, and that there was no difference between figs. 1 and 2, except putting the condensers in the bridge arms.

The Master of the Rolls: Do you mean to say there is no invention at all?

Sir R. Webster replied certainly not; it was a very great invention. This was not at all the case of invalidating a patent.

Lord Justice Lopes: Your suggestion is that, had an action been brought for infringing fig. 2, the patent of 1876 might have been set up as anticipation.

Sir R. Webster: Both would have been English patents.

The Master of the Rolls: I thought you had been saying up till this moment that these patents were precisely the same.

Sir R. Webster: I beg pardon; they are not the same. I put it as distinctly as I could, that the whole combination of the invention of 1880 was identically the same as that described in 1876, but that does not invalidate the American patent. The American law (Sir Richard went on to say) only allows one invention in each patent, and had application been made on the 1876 specification, the American patent office would have said some one thing must be picked out of it. That was why those who went to America picked out the substance, the pith and marrow, of the 1876 specification. That, however, did not in the least invalidate the patent.

The Master of the Rolls: You say, then, the American patent has taken one part, and not put into it anything new whatever?

Sir R. Webster: Beyond the 1876 patent. The two specifications both stated identically the same thing in almost the same words, and the mode of attaining the object was stated in identically the same language. His view was that when in 1880 Mr. Muirhead went to America, he found that what he thought successful in 1876 had not been so successful because he could not reduce the resistance, and accordingly he described in the American patent the best of the combination, the other alternative.

Lord Justice Lopes: Experience having taught him what was the preferable course.

Sir R. Webster: Yes; they took out what they had found by experience the preferable thing. What was done was an extremely

strong argument in favour of his submisson that there was no invention in 1880 beyond that of putting the condenser into the bridge arms so far as fig. 3 was concerned. That was a further development towards dispensing with resistance altogether in the arms, and having what you required in the rheostat. He proposed now to read the evidence of Mr. Alexander Muirhead, the patentee, and he thought their Lordships would come to the conclusion that his (Sir Richard's) view was one which required a substantial answer, and that they would seriously consider whether Mr. Justice Kennedy had arrived at a right conclusion. Both Mr. Taylor and Mr. Alexander Muirhead, he went on to point out, admitted that the reduction in resistance was due to the putting of the condensers into the bridge arms, and it was idle to say that this was the invention; it was a development of the invention. If the main invention was to be found in both patents, the additional development would not prevent the application of the law. In 1880, the bridge condensers were found ineffective, and so the patentees set to work; and if the view he was attempting to enforce was untrue, the great invention of putting in bridge condensers was unprotected in America. The whole of the cross-examination of Sir Frederick Bramwell was directed to proving that the invention of 1876, of putting condensers into the bridge, was one and the same as in 1880.

Lord Justice Lopes: And that the rheostat was common knowledge?

Sir R. Webster assented; and, further, in answer to the Master of the Rolls, said he agreed with Sir Frederick Bramwell's evidence, but he did not agree that the placing of the rheostat was the invention, nor did Sir Frederick Bramwell say it was.

The Master of the Rolls: Nobody has said it.

Sir Richard Webster, proposing to leave to Mr. Moulton the review of the evidence of Lord Kelvin, said he would briefly sum up his position. He had not said a single word to invalidate the 1880 patent, which he admitted was a thoroughly good patent; and if it had been published in America, it mattered not whether or no it was published in England. In the patent an invention was described of putting condensers into the bridge, whether they took the resistance altogether out of the arms or not. In fig. 2 the resistance was still in the arms, and in fig. 3 it was out. The whole question was, aye or no, was there described and patented the same combination as in 1876? and having read to the Court the statement and letter-press of the invention in 1876, he submitted it was identical. If he was not correct, according to the evidence, this putting in the bridge condensers was unprotected in America, and the combination described would not have been infringed had a person taken any single part of it and put another kind of resistance at the apex.

Lord Justice Lopes: It was unprotected in America until 1880?

Sir R. Webster said yes, and after that time, because being a patent of a combination, nothing was protected except the whole combination, but this was not in accordance with the law of England. He had now for a day and a-half been arguing that the rheostat was immaterial with reference to the real invention, and if that were so, Mr. Justice Kennedy took a wrong view of the case.

Mr. Moulton, Q.C., following Sir R. Webster in his arguments, said the duplex system had long been worked on land lines, and was thoroughly understood when the first patent was applied for. The problem which Mr. Alexander Muirhead, whose merits nobody denied, set himself to solve, was its application to submarine telegraphs, and he was the first successfully to apply it to submarine cables, as to which what was known as the Wheatstone bridge had not proved effective. Perhaps he could not better describe the difficulty which had to be met, and was met by the patent of 1876, than by repeating a story reported of Mr. Edison. There had been found to be a great lag in the sending of messages over long cables, and Mr. Edison, sending a little Morse signal of two dots through the transatlantic cable, ran to the receiving instrument to see how it came out. The first dot the celebrated scientist found came out 27 yards long, and so he did not wait for the other. That was only an exaggerated way of putting the matter.

Lord Justice Lopes suppose the current met with great resistance somewhere?

Well, Mr. Moulton answered, it got retarded, it was supposed, by the sides of the cable acting like a Leyden jar, and a message, instead of coming out all at once and sharp, would dribble out to an interminable length, like a straggling army making for its goal, compared with the march of a solid regiment. Mr. Muirhead improved upon that enormously by an invention of very great merit, as everybody admitted and acknowledged, which, by putting condensers in the bridge arms, stopped this lagging, and the messages got through sharper and quicker to the extent of some 40 per cent., to that extent increasing the earning power and value of the cable. This appeared to him to be the answer to the whole judgment of the learned judge below on the matter of fact and the adjustment of resistance, which it seemed to him his Lordship had not grasped. He should show that between fig. 2 of 1880 and fig. 2 of 1876 there was no conceivable difference, and he challenged the other side to show one single practical difference.

The Master of the Rolls: Do you say they are not patents for a means of protecting the balance?

Mr. Moulton said no, they were not; you might vary within wide limits your method of obtaining the balance, but you would be infringing the 1880 patent if you worked that invention.

Lord Justice Lopes: You say the invention is the mode of working the balance when adjusted?

Mr. Moulton assented that that was so. What was before the Court was what was included in the claim of 1880, and he said a man would not be allowed to go and work the condenser and bridge arms, and get the benefits of sharp signalling.

Lord Justice Lopes: You say that the working of the balance is the pith and marrow of the invention?

Mr. Moulton: Of the 1880 patent, certainly; and of the part of the 1876 patent which I care about. The invention in 1880, we say, was something which applied to old machinery, and was made in 1876, and there is nothing in the American patent which contradicts that.

Lord Justice Lopes: You say that the adjusting balance was an old thing?

The Master of the Rolls: Before 1876?

Mr. Moulton said yes, long before 1876.

Lord Justice Lopes: And you might have worked by the Wheatstone bridge but for the lagging?

Mr. Moulton: I say that is so.

The Master of the Rolls: What do you say the 1876 patent is; what did it do?

Mr. Moulton: The invention, the only part I care about, was the getting rid of the lagging by putting the condenser in the bridge arms, from which moment the lagging was got rid of. You could obtain a patent in America in 1880 for what was patented in 1876, and that was what was done here; but it is not enough for our purpose that what was patented in 1880 was patented in 1876. There are several distinct and separate things patented at the earlier date. It is enough for our purpose that one of these should have been patented in 1880. The great invention in 1876 was the use of the condensers in the bridge arms, and that was also patented in 1880. If we show that that was done, it comes within the law with regard to the termination of the American patent as not outliving the English.

The Master of the Rolls: Sir Frederick Bramwell said if any one of the points was left out in the combination it would entirely fail; if that be true, how can you say the second patent is the same as the former?

Mr. Moulton said the combination in fig. 2 of 1880 and fig. 2 of 1876 was the same, and fig. 2 of 1876, it was uncontested, meant the adjustment of resistance. This reduction of resistance was pointed out in 1876, as it was in 1880, and was only rendered possible by the bridge condensers, and the combination was exactly the same.

The Master of the Rolls: Well, the hour of rising has been reached. Before we separate, is not the whole point whether the two combinations are the same?

Lord Justice Lopes: And a combination effecting a substantial improvement?

Mr. Moulton: Yes, I think that is so.

The Court then rose for the day.

Third Day.

This morning Mr. Moulton reminded their Lordships that he had been contending the arrangement of 1880 was the same as in 1876, and, whilst the invention for working more rapidly and without lagging was a great discovery, the power of reducing the resistance in the bridge arms was pointed out in the patent of 1876, as well as in the 1880 American patent. On the decided cases, it was quite sufficient for the appellants' purpose that they should show this. Before he passed from consideration of the 1880 patent, he would point out one or two things from the specification. In fig. 2, R_1 and R_2 in the bridge arms, were described as being adjustable; it was contemplated that the resistance might be varied, and this was precisely the same as in 1876. It was of no consequence how you got resistance in the right ratio, if you could go on working and getting the benefit of the invention. Therefore the appellants put the case in the court below in this way: What would any Court called upon to interpret the 1880 patent say when it was pointed out that in that patent fig. 1 was shown as common knowledge at the time, and differed only from fig. 2 in the putting in the bridge arms. That, they said, was what was secured by the patent in America, and was also secured by the previous patent in England; fig. 1 was common knowledge at the time, and was so described; and the peculiarity of the thing was that that position of adjustment, by putting it in at the apex, so far from being special, was unquestionably the most common arrangement at the time. It was so admitted by the witnesses, besides appearing in a common hand-book of the day (which he produced), describing "Telegraphy in 1874," adopted by the Post Office, and by the Department of Telegraphs for India. The learned counsel was proceeding to quote from page 401 of this book, describing "a convenient device for adjustment," when

The Master of the Rolls said what the Court had to say was whether the point in dispute was novel or not. What they wanted so much to understand was what the learned counsel was arguing. If he was going back on the patent of 1876 as not new, it seemed to him to be irrelevant.

Mr. Moulton said that was not in the least his object, but to show that the 1880 and 1876 patents were identical.

The Master of the Rolls: How can you show that by reading passages from that book?

There was nothing in the 1880 patent, Mr. Moulton replied, making a special position of the rheostat, and the appellants' evidence was that you could adjust the rheostat just as well in one place as in another, and the rheostat being at the apex, was spoken of as common knowledge.

Lord Justice Lopes asked was it not contended in the Court below, and perhaps might be here again, that the placing of the rheostat in the apex differentiated the 1880 patent from the 1876, and was not the learned counsel attempting to show that this could not be so, because the rheostat was a thing well known, and that was the commonest position in which it was placed.

Mr. Moulton said his lordship had explained his position more plainly than he himself had done.

The Master of the Rolls: You say that there is no invention at all in the 1880 patent, but it is a part of the patent of 1876. But if there was something in the 1880 not known in 1876, what then?

Mr. Moulton said his point was that the 1880 did not patent any-

thing that was a new invention. On proposing to deal with Lord Kelvin's attempt to show that the position of the rheostat at the apex was essential,

The Master of the Rolls said it seemed to him the learned counsel declined to face his most important difficulty. He read evidence and books, and talked for hours as to whether the rheostat should be at the apex; but that was not suggested in the patent at all, and to say that this made the whole difference did not carry his (Lord Esher's) mind with it.

Mr. Moulton said it would be satisfactory to go through the patent, as being likely to assist the argument, and proceeding to quote it, he pointed out that its object was described as "more especially to reduce retardation of the signals, and thereby increase the speed of transmission." In the course of his quotations and comments, the learned counsel incidentally said that the only meaning of the rheostat was, that you could vary the length of the two arms and get a right ratio. That might be done by three different modes of arranging a fixed point, the result being precisely the same in either case, and the evidence proved—subject to one point, as to which there was a little conflict—that any electrical tyro would know how to get the ratio. When the balance was got they obtained the 40 per cent. extra power by means of the bridge condensers.

Lord Justice Lopes asked was there anything in the 1880 combination that did not exist in the combination of 1876, and Mr. Moulton replied absolutely none.

The Master of the Rolls: As I understand it, he declined to claim any one of these things by itself, but a combination of them all in the way here shown.

Mr. Moulton assented that that was so, and said the appellants had never contended differently.

The Master of the Rolls: Then what you have to show is, that in the 1876 patent he claimed all the things described in the 1880 patent, and so placed as here with regard to the whole of them.

Mr. Moulton accordingly proceeded to quote the two patents in order to show the identity between them.

Lord Justice Lopes: The learned judge below held them to be identical, did he not, except in the position of the rheostat. And you say, don't you, that the position of the rheostat is immaterial, and cannot constitute a substantial difference.

Mr. Moulton: You put it exactly.

He was continuing his quotations from the evidence and his arguments thereon, when

The Master of the Rolls said: You may go on as long, and talk as long, as you like. All I can say is, that neither the pictures nor the descriptions are the same in the two patents—the figures are not the same and the description is not the same. At his Lordship's invitation,

Mr. Moulton read the evidence of Lord Kelvin in the Court below, as negativing. The Master of the Rolls suggested the idea of common knowledge, on which stress had been laid. On arriving at Lord Kelvin's views with respect to the rheostat, Mr. Moulton said the appellants joined issue with his lordship. Homer sometimes nodded, and his lordship, with all his powers and knowledge, hopelessly blundered in some of the views he took, as was shown by witness after witness accustomed to the practical working of the system. Nobody had suggested that the putting the rheostat at the apex was an idea of Dr. Muirhead's.

The Master of the Rolls: I should hardly expect to find Lord Kelvin "a hopeless blunderer"—a pretty strong expression; and I see he said the putting it in the position was a matter of great importance, by giving a readily adjustable rheostat that could be adjusted by hand by moving a handle.

Mr. Moulton assured his Lordship that it was furthest from his desire to speak disrespectfully of Lord Kelvin; but the importance on which he laid stress was indicated by the fact that it would take, perhaps, two minutes a day to balance the line. Prof. Silvanus Thompson, plaintiffs' witness, was opposed to Lord Kelvin's view, and whilst Lord Kelvin's assistant supported it, and, he believed, nobody else, the whole of the appellants' witnesses took an opposite view. His Lordship, moreover, admitted that the balance could be produced by adjusting the ratio correctly.

The Master of the Rolls: It all comes to this—that he would not agree with what you tried to thrust down his throat.

Mr. Moulton said, with one peculiarity, it was admitted, except by Lord Kelvin, that there was no difference between putting the rheostat at the apex and elsewhere. That was appellants' case, and Prof. Silvanus Thompson, one of the principal of plaintiffs' witnesses, said it was absolutely immaterial.

The Master of the Rolls: You may say that Lord Kelvin was wrong, of course; but it is no use amplifying and repeating that argument. You did not drive him out of his conclusions, that's clear. He contradicted you flat.

Mr. Moulton: Yes; and we called practical witnesses who agreed with Prof. Thompson that it was immaterial. I do not think, after that, my objection to his lordship's conclusions is unfair.

The Master of the Rolls: I think we shall find Sir Frederick Bramwell agreed with him.

Mr. Moulton said Sir Frederick did not deal with the point; and the Master of the Rolls said if that were insisted on perhaps they should see. It would be difficult to get over Lord Kelvin's examination-in-chief, that the rheostat and its use in the particular point indicated was a matter of great importance as having it readily adjustable without putting in or taking out any plug, but capable of being done in an instant by hand.

Which he added was a well known arrangement in rheostats generally, remarked Mr. Moulton; and went on to quote testimony of its being common knowledge in 1874 and 1876.

Lord Justice Lopes thought it impossible to say that the learned judge below had not strong evidence for directing him to the conclusion at which he arrived.

Mr. Moulton said nothing stronger than Lord Kelvin and his assistant, against the practical witnesses and Prof. Thompson. A great number of points had been mixed up.

The Master of the Rolls: Who mixed them?

Mr. Moulton: I think the plaintiffs.

The Master of the Rolls: And they say you did. What have you to say to Sir Frederick Bramwell's opinion that "it gives an extremely reasonable and ready mode of adjustment for the operator?"

Mr. Moulton: That the position of the rheostat on the apex was immaterial. Next turning his attention to the putting of the condensers in the arms of the bridge, he quoted the evidence given on that point (one witness saying that in 1874 he saw a rheostat at the apex), and also in the matter of balancing three or four times a day, finally submitting, as the hour of rising drew near, that the appellants had made out their case.

On Mr. Finlay rising to state the case for the respondents,

The Master of the Rolls said he earnestly hoped that he would deal with the matter in a briefer and a more comprehensive and compact form than had the other side. Considering that there were something like 14,000 questions and answers to be dealt with in the Court below, he never saw a judgment better or more clearly put than it had been by Mr. Justice Kennedy in this case. It seemed to him that the whole point would be met by the learned counsel now saying what was wanting in the patent of 1876, and what the plaintiffs alleged was met by the patent of 1880; and as they were now within ten minutes of the time of rising, perhaps they had all better come to the subject with fresh minds in the morning. If the case were not finished on the morrow, it could not be dealt with on Wednesday, the Court having already arranged for that day the business ordinarily transacted on the present day.

Fourth Day.

Mr. Finlay, Q.C., this morning stated the case for the respondent plaintiffs in the action. The patent of 1880, he said, differed from that of 1876 in several respects, a point which his learned friends on the other side had altogether lost sight of. The 1880 patent admitted that all the parts of combination, taken individually, were old. What plaintiffs claimed for was the invention embraced in this patent—a number of old contrivances so combined as to arrive at a new and patentable result, as being beneficial. The 1876 patent contained no combination at all, in the true sense of the term, but a number of different devices. He did not for a moment concede that the separate elements of the 1880 combination were to be found in the 1876 patent; on the contrary, he denied, and hoped so to prove it. But even if they were, that would not prevent the 1880 patent being a perfectly good combination patent. It constantly happens that patents may be taken out for a number of different things to attain certain results in different ways, and a perfectly good patent may be taken out for a particular combination of these processes. Even if all the elements were to be found in the earlier patent, yet, if a mode has been discovered of combining them to yield beneficial results, that is a perfectly good combination patent.

The Master of the Rolls: That is, if points A, B, C, and D are combined in a perfectly new combination, that combination may be patented?

Mr. Finlay said that was so; but his submission was that the other side had overlooked that consideration, which, it was his contention, lay at the root of this case.

The Master of the Rolls: These patents are for machinery by means of which the electricity may be controlled?

Mr. Finlay said that was so; and, as an illustration, their Lordships would remember that the 1876 patent was, of course, before the Parent Office in America, when an examination took place under the American law, and this having been carefully considered, the 1880 patent was not for any part of the 1876 one, but it was a new patent for a certain combination. That consideration was by itself, he submitted, enough to dispose of the case; but he did not stop there, it was only his first submission. The 1880 patent was for a particular combination, and the 1876 one was not for a combination at all. In support of this view he invited their Lordships' attention to an American book on patents.

The Master of the Rolls said he did not want to see the book. He considered both Sir R. Webster and Mr. Moulton had already overlaid the case with arguments and details which he neither cared about, nor did he think them applicable.

Sir R. Webster: I don't think I did.

The Master of the Rolls: Well, then, you didn't; say Mr. Moulton did, but it was done. Mr. Finlay was going to give up an instance, I suppose on the same lines, and I don't want his instance. Let us consider these two patents apart from so many extraneous illustrations.

In answer to Lord Justice Lopes as to the practice of the American Patent Office, Mr. Finlay said he agreed that whatever it did was not conclusive. The words of the statute, however (which he quoted in full), expressly stated that if a patent be granted (by the American office) for an invention previously protected in a foreign country, shall be so limited as to expire at the same time as the former patent, and if more than one, the time which shall be shortest, and in no case shall be enforced more than 17 years. Though he did not say that what the American Patent Office did was conclusive in this Court, he did desire to point out its practice on the point of limitation.

The Master of the Rolls: Well, now then, give us your illustration; I see you are dying to do it.

Mr. Finlay said the earlier patent would be before the American, and the patent of 1880 contained no such limitation, as was now claimed.

Lord Justice Lopes: Where was the necessity of putting it in if it is the law?

Mr. Finlay said the statute provided it should be put in.

The Master of the Rolls said it seemed to him it mattered but little to this Court whether it was out or in.

Mr. Finlay said his submission was that the limitation not appearing supported his case that the 1880 patent differed from that of 1876.

Lord Justice Lopes asked was the process in America known, and Mr Finlay replied that Mr. Justice Kennedy said he knew it, and he found that a most careful examination of previous patents was made on lines which the learned counsel quoted at length from an American official publication. What was done in the American office he submitted was done rightly, and for the reason that it was a different patent, for a combination, and the 1876 was for no combination at all. This was left out of account of the argument on the other side, as was the further point that the defendants in the action being the licensees of the plaintiffs, were not at liberty to challenge the validity of their American patent. Accordingly the aim of part of their argument had been to mask these defects in their case. The 1880 patent was granted not for any particular part of the 1876 apparatus, but for a combination, and on the face of the specification it was stated as parts of an old patent; and this he submitted was conclusive, three-fourths of the 1876 patent being actually devoted to the provision of a contrivance designed to effect a perfect similarity between the real and the artificial cable—in other words, to secure a balance—means of a totally different character from the simple means provided in 1880, and not so effective as those of the latter date proved. He also submitted that Mr. Moulton was not right in his point that the 1876 patent was for the prevention of lagging after the balance had been obtained. In support of this view he quoted from the specification of the 1880 patent, and the evidence of Sir Frederick Bramwell and Dr. Hopkinson, to the effect that there was nothing in the 1876 patent which would lead him as an electrician to arrive at the combination shown in the 1880 patent. The condensers were in use before the earlier patent, and so the 1880 introduced no new element, but, as far as he knew, they were not before that used in the combination of that year.

Lord Justice Lopes: That is a rather important answer.

Mr. Finlay assented, and submitted that clearly it cut more deeply into the appellants' case than that of the respondents'.

Incidentally, the Master of the Rolls asked what was the length of the bridge arms, and as the result of a good deal of cogitation on both sides, it was said they would vary from a yard or so to the length of the Court.

The Master of the Rolls asked where it could be seen at work; and it being said it was thought not nearer than Valentia, he observed that it was pretty clear he should not go there to inspect it. Later on, Sir R. Webster said he was told there was a complete system to be seen at Woolwich, but it was too heavy to be brought up to the Court; to which the Master of the Rolls said: And he was so heavy that he could not even go there.

It was a great advantage (Mr. Finlay proceeded to say) to have the rheostat at the apex, but plaintiffs claimed the combination whose first element was this disposition, by means of which being connected on one hand with the wire, and on the other with two arms of the bridge, the result was what was called a three-terminal, whereas if it were moved to but one of the arms, it would necessarily be not a three, but a two-terminal. Included in the effects of this was a capacity of almost infinite variation, and a totally different result from what had till that time been attained, under which resistance in the two arms was not constant, nor was there the same aggregate resistance in the two arms, proceeding to support this view by quotations from the evidence of Lord Kelvin.

The Master of the Rolls incidentally asked, was any evidence tendered on the point, had a difficulty been found after the first patent was granted, which in 1880 was overcome. It seemed to him that in the 14,000 questions and answers [Sir Richard Webster: Three thousand, and not 14] everybody omitted to notice and deal with the one question which would settle this point.

Mr. Finlay said Lord Kelvin, being asked what was there known in 1880 not known in 1876, which would enable them to overcome the difficulty in maintaining a balance, replied that they could not obtain a balance without large resistance.

The Master of the Rolls said it was further to be remarked that Mr. Justice Kennedy gave a most careful judgment, and no attempt had been made to show where he was wrong. He laid down certain principles in the clearest way, and applied them, and he should like to be told where he was wrong and where right.

Mr. Finlay said from their point of view the case was settled by a principle of American law that it did not favour forfeiture, and if there was a doubt, the burden was upon the defendant, and the doubt, therefore, should be resolved in favour of the American patent. The view taken by Mr. Justice Kennedy was in accord alike with the evidence tendered to him, and with the evidence of construction of the two patents.

The Master of the Rolls asked was there any evidence that anybody ever used fig. 2 between 1876 and 1880, and Mr. Finlay said he understood it had been tried as an experiment upon—but not applied to—the cable, and proceeded to contend that as licensees could not challenge a patentee's rights in a patent, so defendants in this case could not go behind their agreement to pay a royalty "for the whole period during which the licence shall last."

Mr. Bousfield, Q.C., following on the same side, said this was one of a score of different methods for adjusting resistance, and nobody had pointed out where the rheostat could be put which would discharge the same functions as those embraced in the 1880 patent, the technical advantages of which he pointed out in detail. The device used in conjunction with the condensers enabled the removal of the arms, and gave a large variation of ratio in perfecting the balance, from 0 to infinity on either side, by placing the rheostat in a new and novel position in reference to the bridge condensers. The 1876 specification excluded the notion that he ever had in his mind the idea of using the rheostat in the way covered by the 1880 patent. He had computed the number of permutations to which the combinations might be multiplied as reaching 2,300, and could it be said——

The Master of the Rolls: Oh! pray don't say it. If you ask me, I think you have already said more than enough; we have been saturated with the subject for the last four days, and I really don't know what more can be usefully said in the matter. Surely everything possible has been said.

Mr. Bousfield said he could yet say a good deal more, but as he knew their Lordships were anxious to conclude the hearing to-day, and there was but little of the sitting left, he would refrain, and content himself with the submission already made by his learned leader and himself.

Sir R. Webster being heard in reply on the whole case, submitted that the true construction of the 1880 patent was a claim of a combination of bridge condensers with the parts of duplex machinery essential to those condensers, and American decisions had held that if 1876 would be an infringement of 1880, that would be sufficient identity, and that the rheostat had nothing to do with the getting rid of the retardation, but to adjust the balance.

Having thus exhausted what time was left of the sitting, their Lordships reserved judgment.

Interdict Action by the Edison-Bell Phonograph Corporation, Limited.

In the Court of Session, Edinburgh, on Friday, the record was closed by Lord Stormonth Darling in an action in which the Edison-Bell Phonograph Corporation, Limited, Northumberland Avenue, London, sought to interdict David M'Kinnon, of Kilmarnock, from infringing the letters patent, No. 6,027, dated May 4th, 1886, granted to James Yate Johnson, 47, Lincoln's Inn Fields, Middlesex, for improvements in, and apparatus for, recording and reproducing speech and other sounds, by making, using, or exhibiting any machine or apparatus for recording and reproducing speech and other sound, in which the records are engraved or cut in a waxy or amorphous and slightly cohesive substance, or in which the recording material is composed of a wax or waxy surface, and from infringing the letters patent in any other manner or way. The patent was assigned by James Yate Johnson to the International Graphophone Company by deed, dated October 31st, 1889. The International Graphophone Company assigned the patent to the Edison United Phonograph Company by deed, dated December 31st, 1892. The Edison United Phonograph Company assigned the patent to the pursuers under an agreement dated January 21st, 1893. The pursuers say that the defender has been for some time using and exhibiting machines or apparatus for recording and reproducing speech and other sounds, in which the records are engraved or cut in a waxy or amorphous and slightly cohesive substance, and in which the recording material is composed of a wax or waxy surface, in infringement of the pursuers' letter patent. The defender has been repeatedly warned that in using and exhibiting the machines or apparatus he was infringing the pursuers' letters patent, but he refuses, or, at least, delays to give up the use or exhibition of the machines or apparatus. In reply to the complainants' statement, the defender says that the alleged invention was not new at the date of the said letters patent, especially in regard to the use of wax, and the method of recording sound vibrations in a waxy or amorphous and slightly cohesive substance. In particular, the invention forming the subject of the letters patent was anticipated, as regards all the claims, by an article in a French periodical, called *La Nature*, dated May, 1879, entitled "Lammes parlantes de M. Lambrigot," by the publication in the issue of *Engineering*, dated April 18th, 1879, of an article entitled "A Sixpenny Phonograph," by the publication in the *English Mechanic*, of April 25th, 1879, of an article entitled "A Sixpenny Phonograph," also *inter alia*, by the British specifications of Edison, 1,644, 1878, published in 1878, and by other specifications. The defender denies that he has been using or exhibiting any machine or apparatus in infringement of the pursuers' alleged patent. The phonograph in the defender's possession is incapable of recording sound vibrations on wax or any other substance; it can only reproduce records already formed. This phonograph was manufactured by Thomas Alva Edison or by the North American Phonograph Company, New York (of which Mr. Edison is believed to be the chief director), on his behalf or under his express authority or licence, and was sold by him or the said company, and acquired by the defender through his or their agents.

Lord Stormonth Darling sent the case to the roll for discussion.

Newington, Priddle & Co., Limited, v. Anders Telephone Company, Limited.

In this case, which came before the Lord Mayor's Court last week, the plaintiffs claimed the amount of an account for telephone instruments, &c., supplied, and there was a counter-claim by the defendants for £410 11s. 11d. for loss of sale on alleged defective instruments, establishment expenses during period of non-arrival of the receivers, &c. Mr. Holloway appeared for the plaintiffs, whose claim was admitted subject to the counter-claim. By consent of the parties a formal verdict was returned for the plaintiffs on the claim, and for the defendants on the counter-claim, subject to a reference of the counter-claim to Mr. David Harrison (the Assistant Registrar), who was given full power to deal with all questions.

PROCEEDINGS OF SOCIETIES.

Physical Society, October 26th, 1894.

Prof. A. W. Rucker, F.R.S., President, in the chair.

The meeting was held in the rooms of the Chemical Society, Burlington House.

In opening the proceeding the President said the occasion might be regarded as another sign that the boundary between chemistry and physics was breaking down. On behalf of the Council he tendered the thanks of the Physical Society to the Chemical Society for the use of the rooms.

Prof. H. E. Armstrong, President of the Chemical Society, said his Council offered a cordial welcome to the Physical Society. The change, he thought, would prove of much greater importance than a mere removal. Now that the childhood of the Physical Society was passed, its manhood involved new responsibilities, and great opportunities for good now presented themselves. The Physical Society of London ought now to become the head centre of physics in the United Kingdom. He (Dr. Armstrong) was pleased to learn that the Society had undertaken the preparation and publication of abstracts of physical papers appearing in foreign periodicals, and said the matter was of such great importance that it should be done thoroughly. In a work of such magnitude, he regarded the co-operation of other societies, such as the Institution of Electrical Engineers as absolutely necessary.

The President, in acknowledging the welcome, said the Physical Society was extremely oblized to the President and Council of the Chemical Society for the great benefits conferred. Dr. Armstrong's advice to go ahead would not be forgotten. He then announced that at future meetings tea would be provided for members at 4.30.

FROM THE HUB OF THE UNIVERSE.

"Most people, if asked to-day to name the greatest electrician, would promptly reply "Edison, the inventor of the telephone, &c., &c."

This is the opinion of the author of "Electricians and their Marvels," but leaving alone the fact that Edison did not invent the telephone, the writer has evidently not yet made the acquaintance of George Barnes Pennock, "The Star of All Electricians," as he is dubbed on the front sheet of the annual report of the president of the Pennock Battery Electric Light and Improvement Company, of Boston, Mass. From this precious document, dated October 30th, 1894, we learn that the Pennock system embraces a number of inventions of which we quote the following:—

A perfected primary battery system.
An automatic current feeder.
A voltage distributor.
A multiple current distributor.
An automatic negative pole step-back.
A long distance electric delivery.
A wireless dynamo and transformer.

A proper appreciation of the correlation of physical forces is simplicity itself, compared with the understanding required to follow the marvellous manner in which Pennock rings the changes upon these wonderful emanations of his stupendous brain. "The perfected primary battery will give an output of 2 volts and 75 ampères," and here comes the artfulness of the next item on the list, "the automatic current feeder prolongs the electric life of the battery." Next "the voltage distributor is a machine that multiplies horse-power," and, as if this were not enough, "the multiple current distributor multiplies many times the work done by the voltage distributor.

One would think that a little division or subtraction might now be thrown in, but with a reckless disregard to consequences, worthy of a better cause, "the automatic negative pole step-back duplicates tenfold the work of the multiple current distributor." Then Pennock, apparently unable to multiply or duplicate tenfold any further, brings up distance to lend enchantment to the view. "The long distance electric delivery will deliver electric light and electric power 50 miles from the generating plant, and compete with gas at 5 cents per thousand feet."

This is indeed joyful tidings to electric light supply companies, who are just now somewhat uneasy regarding the threatened rivalry of the incandescent gas lamp, and they will hail with still greater satisfaction "the wireless dynamo and transformer" which adds 300 to 400 per cent to their efficiency.

"We stand before the dawning of a new day in science and humanity—a new discovery surpassing any that has been hitherto made," and it must have been a proud moment for the President of the Pennock Company when giving vent to such remarkable statements as those which here follow:—

"Of such incalculable value are the inventions noted above that if we owned but one (the voltage distributor) of these great inventions our capital stock would easily earn the $50,000,000. Our first patent on the voltage distributor was issued on December 5th, 1893. The second patent (the automatic negative pole step-back) was allowed on July 27th, 1894, and will be issued later on. With this patent and the details that go with it there is practically no limit to the number of electric lights that can be run. *We figured from this patent and details* 180,000 16-*candle-power lights from a basis of* 50 *horse-power.*" . . . . .

"There has been nothing new developed by the old line companies during the past two years to improve their system and make it a commercial success. Our mail is still filled with letters from dynamo users and consumers from all parts of the country, all registering 'kicks.' Some have $10,000 plants lying idle because their maintenance is too costly. Others are losing money both from steam and water-power. Some get six 16 candle-power lamps per horse-power; others get nine per horse-power. Those getting nine lamps per horse-power are losing money. We see nothing in the field to compete with the Pennock system. I have given exhibitions in my laboratory of 56 lights per horse-power. I will increase it to 1,000 lights per horse-power within the next year." . . . . .

"The West End trolley system is a standing menace to life and property in Boston. Did you ever stop and figure on the amount of death dealing current that is carried out on its lines? Take 300 cars as a basis; each car will absorb 50 ampères. That makes a total of 15,000 ampères. Multiply this by 500 volts and you have a grand total of 7,500,000 watts. *This is enough to destroy the city and kill every soul in it.* It is all moonshine on a shovel to talk of putting this current underground; it cannot be done. So there is no help to be gotten from that quarter. Now I tell you what the Pennock system can do. It can duplicate the entire West End plant, that is now using 7,500,000 watts, with a plant consuming but 25,000 watts, and put the wires underground. This would enable the stockholders to get dividends and allow the passengers to be carried for one penny."

The President was scarcely fair in his arithmetic, for even on his own showing the Pennock system might be held responsible for the destruction of one soul in every three hundred.

But with a man who can produce 1,000 electric lights per horse-power, run 100 cars with the power that operates one, and, finally, can duplicate at Buffalo with 100 horse-power, the entire power plant now being erected at Niagara Falls, we must not be too exacting. Of such is the Company of Pennock "who made his first electric light in 1863, and has been in practice ever since." American papers please copy, for it is high time "The Star of All Electricians" retired, so as to give the others a chance.

NEW PATENTS—1894.

20,105. "Improvements in electric measuring instruments." B. Davies. Dated October 22nd.

20,126. "Improved system of fixing agglomerated manganese blocks to carbon or other electrodes." M. M. Bair. Dated October 22nd.

20,127. "Improved porous pot for primary batteries." M. M. Bair. Dated October 22nd.

20,152. "Improvements in incandescent electric lamps." V. Fabris. Dated October 22nd.

20,170. "Improvements in electrical soldering and welding apparatus." H. Zerener. Dated October 22nd.

20,223. "Improvements in electrically worked pumps." R. L. Howard. Dated October 23rd.

20,241. "Improvements in alternating current motors." H. H. Lake. (Communicated by E. A. Clark, United States.) Dated October 23rd. (*Complete.*)

20,259. "Improvements in electrolytic apparatus for decomposing metallic salts." C. Kellner. Dated October 23rd.

20,293. "Improvements in holders for globes or shades of electric, gas, or other lamps." G. F. Sanders. Dated October 24th.

20,317. "Improvements in electric glow-lamps." J. R. Mally. Dated October 24th.

20,330. "Improvements in electro-magnetic machines." I. Vago. Dated October 24th. (*Complete.*)

20,354. "Improvements in and connected with the electro-deposition of aluminium and aluminium alloys." P. Marino. [Date applied for under Patents, &c., Act, 1883, Sec. 103, May 31st, 1894, being date of application in France.] Dated October 24th.

20,363. "Improvements in rests or supports used with telephones for supporting the arms or elbows of persons using the telephones." H. Gilbert and A. B. Gilbert. Dated October 24th.

20,365. "A process for recovery of zinc from scrap galvanised iron and from hard spelter and other zinc alloys." W. S. Rawson and R. Heathfield. Dated October 24th.

20,366. "Apparatus for applying electricity to regulate and control engines or machinery." L. Epstein. Dated October 24th.

20,382. "Improvements in electric telephones and means of signalling thereon." A. C. Brown and G. R. Neilson. Dated October 24th.

20,397. "An improvement for cutting-out electric arc lamps." H. J. Creffield. Dated October 25th.

20,432. "An improved electric bell for mines and outdoor use generally, with damp-proof or hermetically-sealed contact-breaker." F. C. Allsop. Dated October 25th.

20,439. "Improvements in the production of electrical energy and in means or apparatus employed therein." H. Tipping, H. A. Tobias, W. H. Cadman, and R. J. Crowley. Dated October 25th.

20,442. "Improvements in and connected with arc electric lamps." J. E. A. Gwynne and R. Kennedy. Dated October 25th.

20,462. "Improvements in and connected with induced current telegraphy." F. E. W. Bowen. Dated October 25th.

20,482. "Improvements in junction couplings or clips for electric lighting installation." H. A. Cutmore. Dated October 26th.

20,546. "Improvements in electric telegraph systems for working double current translation." S. BUTCHER. Dated October 27th.

20,548. "Improvements in electrical motor fittings for transmitting motion to light machinery." H. LEA. Dated October 27th.

20,561. "Improvements in electric arc lamps." G. W. LOWCOCK. Dated October 27th.

20,595. "Improvements in electrical signalling-devices for railways." W. GRIMES. Dated October 27th.

20,596. "Improvements in or connected with electric accumulators." S. HAMMACHER. Dated October 27th. (*Complete.*)

20,613. "Improvements in electric relays." C. LANGDON-DAVIES. Dated October 27th.

20,614. "Improvements in or connected with electric heating wires or coils." F. W. SCHINDLER. Dated October 27th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS, 1893.

17,172. "Improvements in air and water tight covers for junction boxes used in electrical distribution, and for other purposes." S. W. BAYNES. Dated September 13th. The inventor constructs the lid or cover in such a manner that it passes over the outside of the box or other appliance, and projects down the sides, three or four inches, according to the depth and head of water it is desired it shall resist. A second rim or projecting flange is provided to the inside of the cover and fits into a groove or trough round the edge of the box. The said groove or trough is filled with oil, or other suitable substance, so that when the lid is on and the inside rim submerged for about two inches in the trough, the said combination forms an air and water tight chamber. 2 claims.

18,175. "Improvements in switchboards for telephone exchanges." O. FRANZ and G. OTTO. Dated September 27th. The present invention relates to improvements in multiple switchboards for telephonic exchanges, having the object, as in the case of other multiple switchboards, of enabling the operator to connect the line of any subscriber with any other, on that or on any neighbouring line connected with a multiple switchboard. 1 claim.

18,734. "Improvements in electric meters." H. P. OLSEN. Dated October 6th. Has reference to means or apparatus whereby the two pendulums of an electric meter of the Aron type are held stationary when no current is passing through the meter, and are released so as to set the meter in operation as soon as a lamp or other electrical translating device is switched into circuit. 3 claims.

19,809. "Improvements in carbons for electrodes and other purposes." H. Y. CASTNER. Dated October 20th. Consists in heating the carbon white hot by the passage of an electric current, while the carbon is surrounded by charcoal powder or otherwise protected from any oxidising action. 2 claims.

20,625. "Improvements in and connected with carbon electrode connections." H. T. BARNETT. Dated November 1st. The carbon is manufactured, or subsequently provided with a hole or recess in some portion of its bulk, and in this recess a portion of a so-called "connection" rests, and is retained in position and in contact with the carbon by a wedge or plug. 3 claims.

22,395. "Improvements in electric systems and apparatus." P. E. POWNALL, and R. B. POWNALL. Dated November 22nd. Consists in encasing all parts of the apparatus which are in the mine and at which "sparking" could take place, and maintaining in such casing a constant air pressure, any serious fall of such pressure (owing say to the uncovering or breaking of the casing) being caused to break electrical contact and switch off the entire current from the mine. 4 claims.

23,309. "Improvements in continuous current dynamos for either generating or receiving electrical energy." M. HUTIN and M. LEBLANC. Dated December 4th. Consists in the application to continuous current dynamos closed circuits arranged round the polar enlargements of the field magnets. 3 claims.

23,283. "Improvements in couplings for connecting together conductors of electricity." L. PENSON. Dated December 4th. Over the end of each cable is slipped a gland nut, screwed on the outer part, and internally fitted with an ebonite bush. The outer end of the bushing is rounded or coned to facilitate the entrance of the cable, and the inner end of the bushing is enlarged to form an end collar, against which the inner end of the gland nut is made to abut. Two metal boxes are provided, each enlarged at its outer end and internally screwed there to receive a gland nut, and each is adapted to serve as a stuffing box. The packing used for each stuffing box consists of a few India-rubber washers, which are likewise slipped over the end of each cable. 2 claims.

23,331. "Improvements in electrical current regulators and electrical heating apparatus." S. W. CUTTRISS. Dated December 5th. Relates to the employment of a material of high specific electrical resistance, such as carbon or a mixture, in suitable proportions, of carbon with clays, asbestos, mica or other suitable substances. This material is used in the form of discs or blocks of suitable size and shape. Between the discs, or blocks, are placed thin sheets of metal of relatively much larger area, the object of which is to provide a large surface for the radiation of the heat generated. 1 claim.

21,327. "Improvements in electric meters." E. BERGMANN and C. ERBEN. Dated November 9th. Is characterised by a spring which acts on the oscillating (balance, pendulum, or the like) of a clockwork, being more or less hindered, according to the strength, and eventually the direction, of the electric current, in the freedom of its oscillations, by the action of one or more other springs influenced by the current. This takes place either by the magnetic bodies, which are influenced by the current, being entirely disconnected from, or only indirectly connected with the oscillating system, and therefore not requiring to take part in the oscillations of the latter, or by the duration of oscillation of the driving springs being directly altered by allowing them to act as movable solenoid coils. The speed of the clockwork, which is thus modified, is indicated for the object of registering the amount of electricity consumed, by the difference in the going of the clockwork being compared with a correctly going clock or watch. 2 claims.

23,177. "Improved electric time switch apparatus for closing circuits for various purposes, applicable more especially for actuation by coins." H. J. P. JOLLY. (A communication from G. Richmond, the De La Vergne Ref. Machine Company, New York.) Dated December 2nd. Relates to apparatus applicable to electric lighting, the telephone, and generally apparatus or processes which are dependent upon electricity as a motive force, or whose operation is determined by the making or breaking of an electric current. 9 claims.

1894.

57. "Improvements in electric motor apparatus." W. A. JOHNSTON, A. W. BROWNE, and J. C. DAVIDSON. Dated January 1st. Relates to certain improvements applicable to electric motors of the class employed for imparting motion to dental tools or other devices requiring but little power to actuate them, and embraces improvements in means for starting, stopping, reversing and controlling the speed of the motor; in the arrangement and manner of supporting various parts of the apparatus, and in sundry details. 23 claims.

95. "Improvements in telephonic transmission, and in the art generally of distributing or transmitting alternating currents for power and other purposes." W. H. ECKERT. Dated January 2nd. Consists in the discovery that telephonic transmission, or rapidly alternating currents in general, may be more perfectly effected upon a bimetallic conductor, such as steel and copper in substantially equal parts, than upon a conductor of one material, such as copper. 4 claims.

135. "Improvements relating to the transmission of electric currents and to conductors therefor." M. I. PUPIN. Dated January 2nd. Claims:—1. Overcoming the impedance which long electrical circuits possessing considerable self-induction, static capacity, electrostatic absorption and large time constant offer to variable currents by tuning such a circuit so as to give to it a previously selected periodicity by dividing said circuit into a number of parts, preferably equal and similar, and bringing said parts into inductive relation to each other, either by electro-dynamic or electrostatic induction, or both. 2. The construction and arrangement of an electrical conductor composed of parts or sections placed in series and provided with condensers in circuit with and interposed between said sections, a coil in shunt with each condenser and a closed, or substantially closed, magnetic circuit surrounded by said coil.

495. "Improvements in transformers or converters for electric currents." W. P. THOMPSON. (Communicated from abroad by C. L. Coffin, of Detroit.) Dated January 9th. Claim:—In a transformer or converter, a secondary formed of perforated metal.

666. "Improvements in holders for incandescent electric lamps." J. B. C. EVANS. Dated January 11th. The stem or standard of the holder (to the upper end of which the lamp is connected in the usual manner) is provided with a base adapted to fit the candle sockets formed in two or more parts of vulcanised fibre or other hard non-conducting material. These parts of the base are provided with inclined adjacent surfaces in such a manner that when one part is moved relatively with the other part or parts, the said base will be expanded in order to tightly fit the socket. In conjunction with this divided base a washer is passed over the stem of the holder and approximately fits the candle sockets. 5 claims.

1,003. "Improvements in electric railways." H. H. LAKE. (Communicated from abroad by E. H. Johnson and R. Lundell, both of New York.) Dated January 16th. Relates to improvements in that type of electric railways in which the current main or feeder supplying the propelling current is buried or insulated throughout the length of the entire route, and is provided with sectional trolley conductors or rails located parallel thereto, each of said sectional conductors having means for automatically connecting it to the current main and disconnecting it therefrom as a car or vehicle passes over them, said car or vehicle being usually provided with one or more contacting brushes or trolleys which convey the current to and through the propelling motor located thereon. 27 claims.

1,417. "Automatic device for removing resistance in starting electric motors and replacing same." G. H. WHITTINGHAM. Dated January 23rd. Has for its object to gradually reduce the resistance in the armature circuit of the motor automatically when the current is turned on, and the motor starting by cutting out the coils of resistance one after the other from that of the greatest resistance to that of the least resistance, and maintaining it in this position during the running of the motor, so that when the current through the motor if first completed to start the motor the current will meet with the greatest resistance, and when the motor is fully running there will be least resistance to the passage of the current; this is done to prevent the burning out of the armature of the motor when starting. When the current is shut off, this device operates to automatically replace the resistance in the circuit in readiness to be started again. 7 claims.